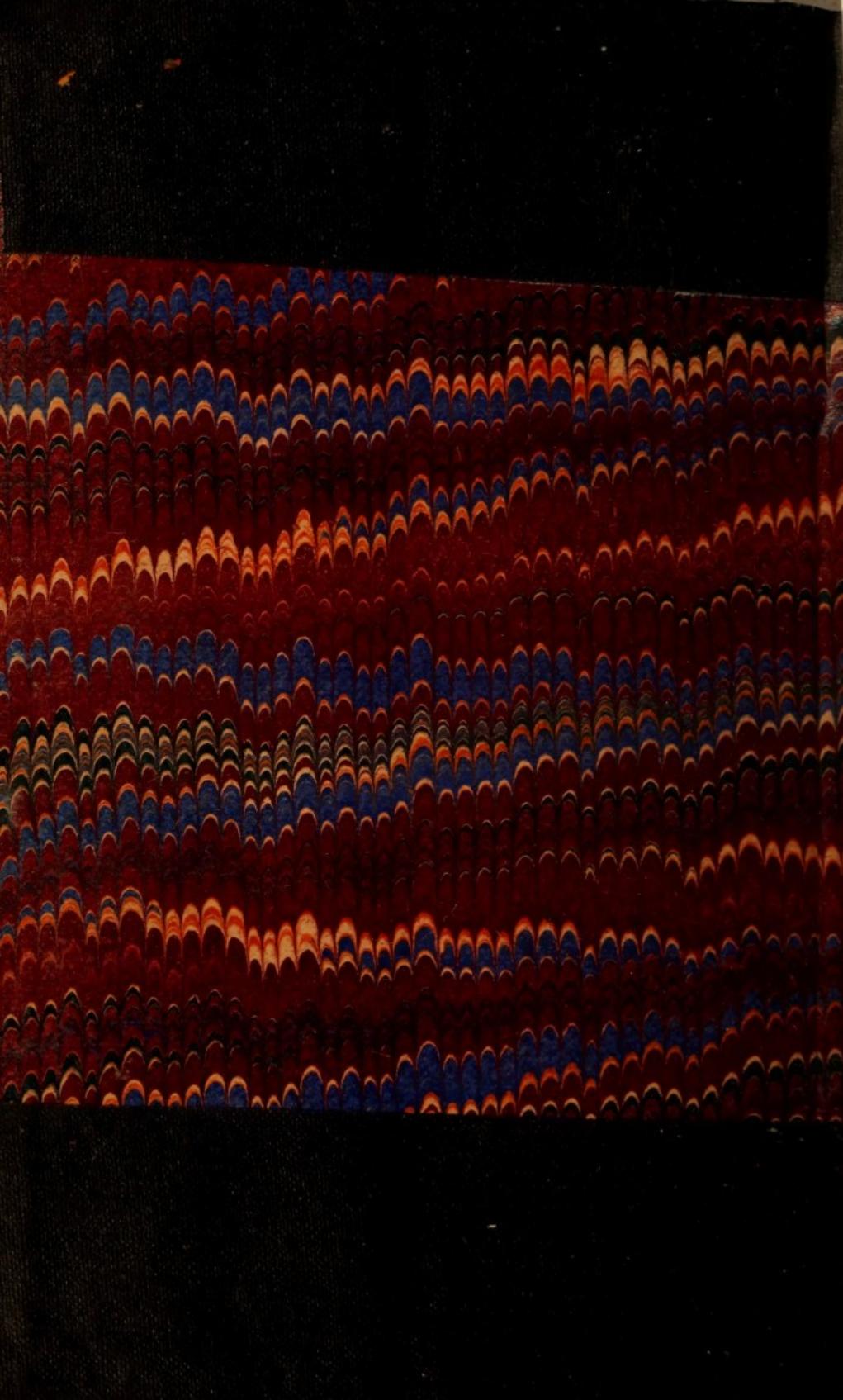




SHIP AND GUN-DRILLS

UNITED STATES NAVY

1905





CLAYTON D. WOOD COLLECTION

SHIP AND GUN-DRILLS

UNITED STATES NAVY.

1905

PREPARED UNDER THE DIRECTION OF THE
BUREAU OF NAVIGATION,
U. S. NAVY DEPARTMENT

AND COMPOSED OF
Lieutenant-Colonel W. F. CLARK, U. S. Navy
Lieutenant-Colonel W. E. SMITH, U. S. Navy
Lieutenant-Colonel W. R. BUCHANAN, U. S. Navy
Lieutenant-Colonel J. T. STAIN, U. S. Navy
Lieutenant-Colonel C. L. LEAN, U. S. Navy

BY CLAYTON B. VOGEL, COLLE

LIEUT. ROBT. W. VOETH, U. S. M. C.

NAVAL INSTITUTE, ANNAPOLES, MD.
1905

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PREPARED UNDER THE DIRECTION OF THE
BUREAU OF NAVIGATION,
NAVY DEPARTMENT

U.S.



BY A BOARD COMPOSED OF

Lieutenant-Commander W. F. FULLAM, U. S. Navy

Lieutenant-Commander W. S. SIMS, U. S. Navy

Lieutenant-Commander W. R. SHOEMAKER, U. S. Navy

Lieutenant C. B. BRITTAINE, U. S. Navy

Lieutenant RIDLEY McLEAN, U. S. Navy

CLAYTON B. VOGEL COLLECTION



NAVAL INSTITUTE, ANNAPOLIS, MD.

1905

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SHIP AND CUN-DRILLS

UNITED STATES NAVY

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the Collision Drill
the Provision Call and Abandon Ship
the Fire Drill
the Fire and Rescue Party
Clear the Deck
General Quarters

PREPAGE

NAVY DEPARTMENT, WASHINGTON,

JANUARY 13, 1905.

This book of Ship and Gun-Drills, U. S. Navy, 1905, prepared under the direction of the Bureau of Navigation, is issued for the use of the Navy.

The instructions contained in this book supersede all others of a similar nature and will be strictly observed.

PAUL MORTON, *Secretary.*

The following named Officers are placed on the Boards in the North Atlantic Fleet to instruct the various classes on Gun-Drills and Notes thereon:

- (1) Sixth Orders and Instructions
- (2) Notes on Drills for Gun-Barrel Gun
- (3) Notes on Signals, Line-Numbers, Miss-Hits, Gun-Drills, Gun-Officer, etc.
- (4) Notes on Drills and Notes of Gun-Barrel Gun
- (5) Drills for Artillery Gun
- (6) Notes on Drills for Secondary and Machine-Guns
- (7) Drills for Secondary and Machine-Guns

PREFACE.

The Board for the Revision of Service Drill Books has classified all drills under three separate heads—*ship drills*, *boat drills*, and *shore drills*—and these have been embodied in three books as follows:

Ship and Gun-Drills, U. S. Navy, 1905.

Boat-Book, U. S. Navy, 1905.

The Landing-Force and Small-Arm Instructions, U. S. Navy, 1905.

In determining the contents of these volumes due consideration has been given to the question of convenience in use. For example, in order to reduce the bulk of the shore book to a minimum, certain subjects, such as physical exercises with and without arms, are included with ship drills.

SHIP AND GUN-DRILLS.

This drill-book is designed to cover, so far as practicable, all drills and exercises which are carried out exclusively on board ship.

It is divided into seven parts, which are briefly described below. An Order of Subjects precedes each part.

Part I. (1) Organization.

(2) Practical Naval Gunnery.

II. GUN-DRILLS AND NOTES THEREON.

(1) Safety Orders and Precautions.

(2) Notes on Drills for Main-Battery Guns.

(3) Notes on Sights, Firing-Attachments, Miss-Fires, Primers, Gas-Checks, etc.

(4) Notes on Turrets and Turret-Mounts.

(5) Drills for Main-Battery Guns.

(6) Notes on Drills for Secondary and Machine-Guns.

(7) Drills for Secondary and Machine-Guns.

III. EMERGENCY-DRILLS.

- (1) Collision Drill.
- (2) Provision Call and Abandon Ship.
- (3) Fire Drill.
- (4) Fire and Rescue-Party.
- (5) Clear Ship for Action.
- (6) General Quarters.

IV. SMOKELESS POWDER, GUN-COTTON, AND TORPEDOES.

- (1) Smokeless Powder.
- (2) Gun-Cotton.
- (3) Torpedoes.

V. NOTES ON ORDNANCE MATERIAL.

VI. PHYSICAL EXERCISES.

VII. MUSIC AND BUGLE CALLS.

In the preparation of this book, the board as a whole has passed upon the contents of each chapter.

The following named officers have rendered material assistance to the board, in some cases preparing or revising complete chapters:—

Lt.-Comdr. A. C. Dieffenbach, U.S.N.	Lieut. J. H. Sypher, U. S. N.
Lieut. L. C. Chandler, U. S. N.	Lieut. F. H. Clark, Jr., U. S. N.
Lieut. S. S. Robison, U. S. N.	Lieut. A. G. Kavanagh, U.S.N.
Lieut. A. B. Hoff, U. S. N.	Lieut. R. W. McNeely, U. S. N.
Lieut. L. M. Nulton, U. S. N.	Lieut. W. S. Turpin, U. S. N.
Lieut. L. R. de Steiguer, U. S. N.	Lieut. J. W. Graeme, U. S. N.
Lieut. C. D. Stearns, U. S. N.	Surg. C. F. Stokes, U. S. N.

The following named officers served from time to time on the Boards in the North Atlantic Fleet which compiled the drills for the various classes of guns:

Turret Guns.

Lieut. L. R. de Steiguer, U.S.N.	Lieut. T. S. Wilson, U.S.N.
Lieut. W. K. Harrison, U.S.N.	Lieut. W. P. Scott, U. S. N.
Lieut. L. A. Bostwick, U.S.N.	Lieut. J. M. Luby, U.S.N.
Lieut. A. L. Willard, U.S.N.	Lieut. H. C. Mustin, U.S.N.
Lieut. F. H. Clark, Jr., U.S.N.	Lieut. C. A. Abele, U.S.N.
Lieut. C. J. Lang, U. S. N.	Lieut. J. W. L. Clement, U.S.N.

Auxiliary Battery.

Lieut. J. F. Carter, U.S.N.	Lieut. A. W. Marshall, U.S.N.
Lieut. F. L. Sawyer, U.S.N.	Lieut. E. P. Jessop, U.S.N.
Lieut. F. A. Traut, U.S.N.	Lieut. L. S. Shapley, U. S. N.
Lieut. E. H. Campbell, U.S.N.	Lieut. C. Shackford, U.S.N.
Lieut. O. P. Jackson, U.S.N.	Ensign B. B. Wygant, U.S.N.
Lieut. W. S. Turpin, U.S.N.	

Secondary Battery.

Lieut. W. C. Cole, U.S.N.	Lieut. E. T. Fitzgerald, U.S.N.
Lieut. R. C. Bulmer, U. S. N.	Lieut. C. W. Cole, U.S.N.
Lieut. J. V. Klemann, U. S. N.	Lieut. J. W. Greenslade, U.S.N.
Lieut. J. H. Holden, U.S.N.	Ensign C. P. Snyder, U.S.N.
Lieut. R. Earle, U.S.N.	

Full use has been made of the various pamphlets and handbooks on subjects incorporated herein, and particularly has the board availed itself of the drill-book entitled "Gun and Torpedo Drills, U. S. Navy," prepared by Lieutenant E. W. Eberle, U. S. N., in 1900, much of which has been included in its original form.

PART I
ORGANIZATION
AND
PRACTICAL NAVAL GUNNERY

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ORGANIZATION.

COMPLEMENT.

1. (1) The complement of a ship will be based upon the number of men required, as follows: (a) to give every gun and torpedo-tube a full crew, (b) to supply ammunition during a protracted engagement, (c) to give a sufficient engineer's force for battle conditions, (d) signalmen, including range-finding parties and battle messengers, (e) electricians, (f) helmsmen and leadsmen, (g) surgeon's assistants.

(2) **Marines** will be added to or included in the complement as decided upon by the Navy Department.

(3) **Officers**, in number and in rank, will be ordered as decided upon by the Navy Department.

(4) Every officer and every man shall have a regular station for battle, to which he shall promptly repair at the call for General Quarters.

(5) **Navy regulations.**—Art. 391, par. 2 of the U. S. Navy Regulations, 1905, provides as follows: “The complement of the ship shall be organized into divisions according to the plan deemed most advisable. In regard to the battery he shall assign the watch and division-officers to the command of gun, powder, and torpedo-divisions in a manner that will, in his judgment, most conduce to the efficiency of the ship as a whole, and shall make no changes in such assignment except to the same end. The personal command of any officer at the battery, in battle or for drill, shall include, as far as practicable, only one class of guns—heavy, intermediate, or secondary, from which command he shall not be displaced simply because of difference in rank.”

GUN-DIVISIONS.

2. (1) **The gun-divisions.**—The guns will be grouped into “divisions,” with the object of having, if practicable, the fire of all of the engaged guns of a division under the observation of the division-officer in action. A gun and its opposite will belong to the same division, so as to reduce the number of guns in a division which are likely to be engaged at any one time, and in order always to have all division-officers and a portion of each division on the engaged side.

(2) *Main-battery guns on different decks*, will not be assigned to the same division where it is at all practicable to avoid it, nor will main-battery guns of different calibers be assigned to the same division, unless it is necessary to do so.

(3) *A pair of heavy turret-guns* which may fire on either broadside will, together with their ammunition-crews, constitute a gun-division. Both pairs of guns in superimposed turrets, and their ammunition-crews, will belong to the same division.

(4) *Broadside turrets*, or turrets whose guns fire on one side only of the fore and aft line, will be assigned in pairs to divisions, each such turret and its opposite constituting a pair.

(5) Such a pair of turrets may constitute a very important part of the end-on fire, and provision must be made for utilizing both turrets of the pair to the best advantage when end-on fire is employed.

(6) If such fire should cover a considerable interval, the officer from the unengaged pair may be ordered to take charge of one of the engaged turrets.

(7) These pairs of turrets, and superimposed turrets, must be favored in the assignment of junior-officers of divisions and turret-captains.

(8) *Secondary-battery guns* (of 3-inch caliber and below) will be grouped in a division, or divisions, as may be most practicable, without regard to their calibers.

(9) A number of these guns will be manned by marines; but marine crews will not be permanently assigned to guns of the main battery without referring the subject to the Navy Department. As far as consistent with the above, the divisions should, as nearly as practicable, be made equal in offensive power and in the intelligence and numerical strength of their personnels.

PERMANENCE IN GUN-STATIONS.

3. (1) The primary object of a man-of-war, especially a battleship, is to fight with her guns; therefore, her organization should be with this object in view.

(2) *A full and permanent crew for every gun is of vital importance.* Rapidity of hitting is the object sought, and it cannot be attained unless the crew is sufficient in number to insure an abundant supply of ammunition *at the gun*. Permanence in stations at a gun of a particular type, where men have been trained to a high degree of skill and efficiency, is equally important, and for this reason no man who has been so trained at a gun of a particular type, shall be transferred to another station or gun unless his qualifications entitle him to promotion to a more important station or gun, whereby the efficiency of the battery, as a whole, will be increased.

(3) *Permanence of officers in divisions* is also of the highest importance. To this end only such changes will be made among the officers and men, in the divisions, as will promote the efficiency of the ship as a whole, and those changes which may be unavoidable, will be made as soon after a target-practice as practicable, so that the training, under the new conditions, for the next target-practice may be begun as early as possible.

(4) To enable the watch on deck to clear away all the guns in an emergency, the crews will in the beginning be made up, as far as possible, of an equal number of men from each watch, and afterwards in no case will changes be made in gun-crews to accommodate the numbers of the watch-bill.

4. Ammunition-crews for turret-guns which have handling-rooms will be a part of the division to which their turrets belong, and their division-officer will be held responsible for their efficiency. The ammunition-crews will be full and permanent in their stations, in like manner to the gun-crews.

STATIONS FOR SHIP'S WORK AND BOATS.

5. (1) In distributing the men of the gun-divisions for other stations and for ship's duties, they will be assigned, as far as practicable, to that part of the ship most nearly embracing the guns of their division, thereby causing a closer association among the men, having them always commanded by their division-officer, and increasing their interest in the care and cleanliness of their guns and their locality.

(2) A gun-crew or an ammunition-crew must be trained and drilled as a unit. For this reason, it is considered better to take all the men of one or two units to man a boat, or perform other work which must be done during a drill period, than to take one or two men from several units.

(3) The efficiency of the ship, as a whole, will be promoted by keeping the gun-crews intact under their own gun-captains, in other ship's duties and drills, and in boats.

(4) No man should be assigned to a gun if the duties of his rating do not permit him to be present at the regular drills of the crew; he should be assigned to other duties where his attendance at a stated time is of less importance.

POWDER-DIVISION.

6. (1) The powder-division will supply and hoist all ammunition for all guns, except for those turret-guns whose ammunition supply is situated so that it may be handled by the turret ammu-

nition-crew, under the control of the turret-officer. All other magazines, shell-rooms, fixed-ammunition rooms, gun-cotton rooms, and ammunition-hoists shall be under the charge of the officer of the powder-division, and he will be responsible for the supply of ammunition from them.

(2) He is responsible for the testing of flood-cocks, the safety inspections, cleanliness, lighting, stowage, and the efficient condition generally, of *all* magazines and shell-rooms, and receptacles of that nature; for the efficiency of all ammunition-hoists not connected with the turrets; and for preparations to quickly flood any magazine or shell-room, should an emergency require it.

(3) **The officer of the powder-division** will bestow much care and thought upon organizing and stationing the men of his division so as to give an adequate supply of ammunition to the battery, and he will provide for all the emergencies on the lower decks that can be foreseen.

(4) He will distribute the petty-officers and leading-men of the powder-division so as to have a capable man in charge of every magazine, shell-room, and at other important points. There will usually be in his division a number of chief and other petty-officers, and their intelligence and capabilities must be fully utilized in getting efficiency from a division that is distributed through wide limits.

• (5) He should make these petty-officers responsible to him for the supply of drinking-water for their stations, and for the working of fire-hose and watertight doors and hatches in their vicinity, in cases of emergency requiring it, as well as for the efficient supply of ammunition.

ENGINEER FORCE AND MARINES FOR POWDER-DIVISION.

7. (1) Men from the engineer force may be assigned to the powder-division in accordance with the U. S. Navy Regulations.

(2) For collision and fire quarters the scope of the engineer force will be enlarged to embrace that part of the berth-deck adjacent to engine and fire-rooms, and men of that force will be stationed to close watertight doors, man fire-hose, and for other similar work, the senior engineer officer being responsible for the proper performance of these duties.

8. **Marines** will be assigned in accordance with the U. S. Navy Regulations; they may, however, be detailed to the powder-division, not below the protective-deck, in sufficient numbers to supply the ammunition for the guns manned by marine crews. These

marines, under the officer of the powder-division, will, where practicable, be utilized for supplying ammunition for marine-manned guns only. Where this is not practicable they may be utilized to supply ammunition for guns similar to those manned by marine crews, but they are not to be generally distributed through the powder-division. Marines detailed to the powder-division may be stationed to close watertight doors and hatches and to man fire-hose, in the vicinity of their battle-stations.

THE TORPEDO-DIVISION.

9. For the present, torpedo-crews will form a sub-division of the powder-division, each group or pair of tubes being under the direct charge of a capable assistant to the officer of the powder-division. The crews will be permanent, and they and the assistants in direct charge will be selected with great care, frequently exercised under battle conditions, and kept at a high degree of expertness in the use of these powerful offensive weapons. The developments of the near future may warrant making the torpedo-division a separate division, under a specially detailed officer, who will also have charge of the submarine mining.

CREWS IN RESERVE.

10. (1) **Preservation of gun-crews** is essential to success in battle, and needless exposure of them must be avoided.

(2) *The crews of unengaged guns* will be sent, "in reserve," behind the armor of turrets, barbettes or casemates, and kept there until required at their guns, or to man other engaged guns, or for other special purposes. This applies to secondary-battery guns and light guns of the main battery, on the engaged side, when the enemy is beyond their effective range. The question of the utility in battle of the guns of the secondary-battery must depend upon the nature of the enemy, and upon special circumstances.

(3) *Reserve-stations* for crews will be designated by the commanding officer, and the crews will be exercised at occupying them. These stations will be such that division-officers can readily communicate with their reserve-crews, and the crews must be on the alert for orders. Reserve-crews will be sent to their quarters by the command, MAN ALL THE GUNS, or MAN ALL THE 6-INCH GUNS, etc., or individual crews may be ordered to man their own or opposite guns, or individual members of crews may be ordered to opposite guns, or, if necessary, to any guns on the engaged side. A whole engaged broadside will not be simul-

taneously relieved by crews in reserve, but will, if necessary, be relieved one crew at a time, so as to suffer the least interruption of fire.

(4) *Shellmen and powdermen*, or other members of reserve-crews, will, if necessary, be utilized in unboxing and assisting in the supply of ammunition for the engaged guns.

(5) *The reserve-crews*, generally working by crews, will serve as firemen, wreck-clearers, aids to wounded, riflemen, to replace wounded on the engaged side, and, in fact, in any extra service which may be required in their vicinity, leaving the engaged crews complete to maintain their maximum fire. No engaged crew is to be weakened by calling away members of it, as long as there remain men of the crews in reserve.

ENGAGED CREWS.

11. If men from the engaged crews should be required as firemen, wreck-clearers, etc., whole gun-crews, designated by the executive officer from the least effective guns, will be sent, not weakening all the guns by sending a few men from each crew.

ARMS AND EQUIPMENTS.

12. Officers and specially detailed petty-officers, at all drills and exercises on board ship, will be armed with the pistol only. All officers whose battle-stations afford an outlook will wear binoculars if they can be supplied.

13. Gun-crews will wear no arms, nor will belts and arms be supplied for them in the vicinity of their guns. Opportunities for the employment of boarders and riflemen are not considered within the probabilities of a modern naval engagement. Arms, either in racks or about the decks, in the vicinity of the personnel, are likely to become dangerous missiles; this fact, and the necessary exposure of the men using rifles, more than offsets the slight damage the rifles might be expected to inflict upon the enemy. To provide for a possible use which cannot be foreseen, rifles and pistols and filled belts will, in action, be kept in accessible protected places known to all officers and men, where they can, in an emergency, be obtained without great delay.

14. Crews of automatic and machine-guns, below the one-pounder in size, will be provided with a rifle and filled belt for each member of the crew, to be used as alternative weapons, should the automatic or machine-guns become disabled.

15. Marines may be specially detailed as sharpshooters.

16. The above rules do not preclude the employment of riflemen against torpedo- and submarine-boat attacks, as referred to under another heading.

RESISTING TORPEDO ATTACKS.

17. (1) It is assumed that torpedo attacks will usually be made by a number of boats attacking from different directions according to a prearranged plan.

(2) The appearance of one or more boats should not so divert or confuse the defense that other boats may come within torpedo range unobserved, or unprepared for. The attack should never come as a surprise, but, when within the bounds of possibility, will be anticipated, and preparations for successfully resisting it will be made accordingly.

(3) Every gun up to and including 6-inch, and on occasions where considered desirable the 7-inch, will be in readiness.

18. **Shrapnel** may be used by the calibers for which it is supplied; the other calibers will use common shell. Every gun of the calibers to be used will have a prescribed arc in which to fire and over which its crew will watch, with the gun cast loose, loaded and trained to the middle point of its arc. If no enemy appear in its arc, the gun will fire at the nearest enemy upon which it will bear; but while thus firing beyond its assigned arc, at least two members of the crew will keep a careful watch in its arc, taking no part in the service of the gun. On sighting an enemy in that arc they will give the signal, and the gun will at once change its fire to its own arc. The ammunition-cars of turret-guns will be loaded and ready to hoist; the other main-battery guns will have at least five rounds of ammunition near the gun; secondary-battery guns will have at least twenty rounds near the gun; the small caliber automatic and machine-guns will have at least 500 rounds each. Owing to the delay in setting fuses, shrapnel will be provided in groups of five, with fuses set at $\frac{1}{2}$, $\frac{3}{4}$, 1, and $1\frac{1}{2}$ seconds and with unset fuses.

19. During daylight attacks, ranges will be measured and transmitted to the battery, as far as practicable; there should be, if possible, a range-finder for every arc, to measure continuously and transmit the range to the guns in that arc. In the absence of efficient methods of fire-control, the sights of half of the guns in every arc will be set at the transmitted ranges for that arc, and the other half at 100 yards short of the transmitted ranges. Shrapnel fuses will be set at about 200 yards short of the trans-

mitted ranges, using those with previously set fuses when the times for which they are set would apply.

20. (1) At night, and in fog, thick rain or snow, ranges cannot be measured; and in the absence of efficient means of controlling the fire of a large number of small guns firing in different arcs, from one or more positions having reliable communications with the guns, some fixed range must be decided upon. The range of visibility for any special condition will be a guide for the ranges at which sights are set for opening fire. The actual conditions should always be fully considered, and, if necessary, a fixed range decided upon. All reliable data must be made use of to correct ranges, but constant changing of them, without such data, must be avoided.

(2) It is suggested that at night, under ordinary conditions, the sights in every arc should be set, half at 1000 yards, and half at 800 yards, and shrapnel fuses at $\frac{3}{4}$ seconds, dropping the sights to point-blank and using $\frac{1}{2}$ second fuses should the night be very dark or the enemy appear very close.

(3) *All search-lights* will be manned and ready for instant use at night, the arcs through which they are to sweep being prescribed. The men who direct the search-light beams should be trained to expertness.

21. **Turret-crews.**—The gun-crews and ammunition-crews of the turrets which are not employed, and the available marines, will be distributed to serve as lookouts and riflemen, the former being placed where they could quickly be called to their turrets. Should the conditions insure that the attack could be made on but one side, unengaged crews may be distributed as riflemen on the engaged side, the rifles and filled belts being provided for that purpose. All available officers should be stationed, with glasses, as lookouts and to render every possible assistance in getting the range. Quick pointing of turret-guns, at night, will be facilitated by having a visible line on top of the turret, establishing the vertical plane parallel to the axis of the gun, which line may be used to assist the trainer in getting on the target.

RAKING FIRE.—RAMMING.

22. (1) In ships with guns mounted on open decks or with guns not in armored casemates, the men and guns should not be exposed to a raking fire.

(2) At the command STAND BY FOR RAKING FIRE FROM FORWARD (or AFT), the guns which do not bear on the enemy, or are not

effective, will be trained sharp on the bow (or quarter), in order to present the smallest possible targets, and their crews will be ordered in reserve, behind the best protection at hand.

(3) These crews will man their guns at the command MAN THE STARBOARD (OR PORT, OR SUCH AND SUCH) GUNS.

23.(1) **Ramming.**—If the maneuver is to ram the enemy, the guns which do not bear, or are not effective, will be trained sharp on the bow and their crews ordered in reserve, as above. Effective guns that can be brought to bear should not cease their fire in either case. When attempting to ram, set sights at point-blank when the range has decreased to 500 yards.

(2) Article 1619, Par. 3, U. S. Navy Regulations, 1905, requires that "When it is intended to ram, or when the vessel is likely to be rammed, notice will be given from deck to the engineer officer of the watch, through the speaking-tube or by other prompt method of signalling, so that men, tools, etc., may not be thrown down or against moving parts of the machinery."

REPAIR-STATIONS AND REPAIR-PARTIES.

24. (1) The ability to quickly repair damages may decide the issue of a battle. It is left to individual ships to organize an efficient repair-force, since much of the detail must depend upon the nature of the ship.

(2) The following outlines are to insure that some steps toward it will be taken:

(a) In large ships there shall be two places, preferably one forward and one aft, designated as repair-stations; they should be below the protective-deck, and easily accessible. At CLEAR SHIP FOR ACTION they will be provided with an assortment of useful tools, and with the special appliances for making quick repairs.

(b) In small ships one repair-station will be designated and provided as above, and one repair-party detailed.

25. **The carpenter** will, in addition to his duties with the powder-division, be in general charge of the repair-party. The nucleus of such a party—a carpenter's-mate, a blacksmith, and an electrician—should be at or near each station. The powder-division duties of these men should be such as to bring them in the vicinity of their repair-stations, and permit of their absence for repairs without seriously affecting the supply of ammunition. Men who may be rendered idle, as a result of the damage to any part, will work with these parties in a united effort to speedily effect the necessary repairs.

26. In the engineer force there are many skilled mechanics who could render valuable assistance to repair-parties; and while it is not intended to relieve such men from their engine or fire-room stations for repair work outside those limits, provision should be made for utilizing some of them, when for any reason they are relieved from the engine or fire-rooms.

AID TO WOUNDED.

27. (1) In case of a casualty among the members of an engaged gun-crew, the two most available men nearest to the wounded man will, without orders, remove him clear of the gun, and if necessary (that is, in case the gun is in an isolated position, or in case the members of the relief-station crews are not present), give him first-aid.

(2) As soon as the wounded man is placed out of the way of the working of the gun (and when necessary first-aid applied), those who have removed him will at once resume their duties at the gun.

(3) Generally, a shellman and a powderman (in broadside gun-crews) could remove a casualty with the least interruption of gun-fire, and when such men are convenient to the wounded man, they will consider it their duty to remove him. As a very general rule, it may be noted that the plugman and the members of the gun-pointer group cannot leave their stations without interrupting the fire of the gun, and hence if other men are equally convenient, these men should not cease the performance of their individual duties.

(4) Attention is invited to Part III, Arts. 95 to 103, "The Medical Department in Battle," which provides for the care of the wounded after they have been placed clear of the gun. When necessary, the reserve-crews may be utilized, by special order of the division-officer, to assist the relief-station crews to transport the wounded from the guns to the nearest relief-stations.

(5) So far as practicable, all members of the ship's company will be instructed by the medical officer in applying the "first-aid" dressing; but in action, except as specified above, men will never be drawn from engaged crews to assist the wounded. Also, as unengaged crews may at any time be called upon to engage, they will, when utilized for this purpose, only assist the wounded men to the relief-stations, where the medical officers or the relief-station crews can attend to them; then return to their battle-stations.

(6) Those wounded at turret-guns, or in other positions so

isolated that their removal would entail an interruption of fire or be accompanied by serious inconvenience to the wounded men, will be so disposed of as least to affect the fire and the morale of the gun-crew. It will usually be impracticable to remove them until after the action. Sending wounded below, from turret-guns, in the ammunition-cars will be resorted to only when the service of the gun renders their removal from the turret necessary, and when this method would cause less delay than ridding the turret of them by other methods.

NUMBERING THE GUNS AND TORPEDO-TUBES.

28. The starboard guns of a battery will be designated by odd numbers, and the port guns by even numbers, beginning forward. The guns of each caliber will have a separate series of numbers. When guns of the *same caliber* are on *different decks*, the guns on the lowest deck have the lowest numbers. The right guns of turrets will have odd numbers, the left guns even numbers. This method eliminates the necessity of remembering a long list of numbers in order to designate guns; thus, the right gun of the forward 12-inch turret will be *12-inch No. 1*; and the left gun, *12-inch No. 2*; the right gun of the starboard forward 8-inch turret will be *8-inch No. 1*; the left gun, *8-inch No. 2*; the right gun of the port forward turret will be *8-inch No. 3*; the left gun, *8-inch No. 4*, etc. The starboard forward 6-inch gun will be *6-inch No. 1*; the port forward 6-inch gun will be *6-inch No. 2*; there would also be *3-inch No. 1, 2, 3*, etc.; *6-pdr. No. 1, 2, 3*, etc. The turrets, when there are more than two of a class, will also be numbered, by classes, serially, from forward aft. Where guns, not in turrets, are mounted to fire on either side, the forward gun will be No. 1 of its class, and the after one the last number of its class. The torpedo-tubes will be numbered serially from forward aft, the starboard tubes having the odd numbers.

QUARTER-BILL.

29. (1) Every ship will have a comprehensive *Quarter-Bill* showing the battle-stations of officers and men, and showing, in detail, what is to be done at the call to general quarters, and in action, in the same way that complete *Fire*, *Boat*, *Clear Ship*, and *Collision-Bills* show the details of those exercises. In its scope the *Quarter-Bill* will embody the whole ship, and in its detail it will provide for every contingency of battle that can reasonably be anticipated.

- (2) It should comprise the following:
- (a) The procedure at *Fire in Action*.
 - (b) The stations for *Crews in Reserve*, and their part in the supply, unboxing, etc., of ammunition for the engaged crews.
 - (c) The officers and men to *Find and Transmit the Range*, and the methods to be used.
 - (d) Defense against *Torpedo Attacks*, prescribing arcs for guns and search-lights.
 - (e) Methods of *Fire-Control*.
 - (f) The use to which *Secondary-battery Crews* are to be put until called to their guns.
 - (g) The stowage and supply of *Ammunition*, and where the reserve supply, if any, will be kept.
 - (h) Where *Rifles* and *Pistols* and their ammunition are to be obtained.
 - (i) The *Repair-Parties* and locations of repair-stations.
 - (j) The successive emergency methods for *Steering*, and the helmsman for every station.
 - (k) The *Watertight Doors* and *Hatches* that are to be left open and those who are to close them in an emergency or when signal is made.
 - (l) The locations for "*First-Aid*" Stations, and show clearly what is to be done with the wounded from every division.
 - (m) Where *Spare Parts* and *Gun-Gear*, of a general nature, are to be kept.
 - (n) The meaning of *Bugle Calls*, etc., etc.

GENERAL-ALARM AND CALLS.

30. The general-alarm gongs will be rung to indicate an emergency and the necessity for the promptest action on the part of officers and crew.
31. (1) The call will indicate the nature of the emergency, and should be sounded simultaneously with the general-alarm gongs, in order that the watch on deck and the men about decks may be promptly informed. The call will be repeated after the gongs have stopped, and will be sounded in the men's sleeping quarters, so that all may know where to go, without confusion and delay.
- (2) To this end also, it will be made the specific duty of the junior-officer of the watch, the quartermaster, a signal-boy, or an anchor-watch, to inform the engine-room, by voice-tube or

telephone, of the nature of the emergency, as soon as the call has indicated it, in order that the person in charge there may know what is required.

32. **General quarters** will be indicated by the ringing of the general-alarm gongs, accompanied and followed by the bugle call, the latter repeated as necessary.

33. (1) **Fire-quarters**, *except in action*, will be indicated by the ringing of the general-alarm gongs, accompanied and followed by the rapid ringing of the ship's bell, and the fire-call sounded on the bugle; one stroke of the bell at the end of the rapid ringing will indicate fire forward; two strokes, fire aft.

(2) *In action*, the fire-bell will not be rung, but all hose will be kept led out ready for use, and the divisions will extinguish fire in their own neighborhood.

34. (1) **Collision**, or other emergency requiring the closing of watertight doors, will be indicated by the general-alarm gong, one long blast of the siren, and the solenoid whistles, repeating the latter two as necessary.

(2) *In action* the siren will not be sounded, but the solenoids will be, in cases requiring the closing of those doors which would be open in battle. In battle, open doors and hatches will be few in number, and should be limited to those absolutely necessary for the efficient supply of ammunition, for communication, etc.

35. **Abandon-ship**.—The signal to prepare to abandon ship will be the *Provision-Call*, repeated below where necessary. It should be sounded after watertight doors are closed. This call will also indicate that boats are to be gotten ready. When the boats are provisioned and ready to abandon ship, they will be lowered by verbal commands, precautions being taken to prevent accidents.

36. (1) **The secure** will be sounded by the buglers, at the end of any exercise. Everything will be promptly secured, or opened up, as the case may require, after which the men will fall in at their quarters for muster, except:

(a) After general quarters and gun-drill, the crews of guns not in turrets will fall in at the guns.

(b) After securing from boat exercises, they will fall in abreast their boats.

(2) If *secure* is sounded after a collision drill which has been followed by either Provision-Call, Abandon-ship, or both, the boat-crews will first secure their boats, then open watertight doors without further signal, then fall in abreast the position at which their boats are equipped.

37. **The retreat** is the signal for dismissal, for which the command will be DISMISSED. It may be sounded immediately after an emergency or routine signal, to nullify that signal.

38. **The officers' call** will be sounded, as a preparatory signal, five minutes before routine calls which require the officers' presence. When sounded during a general exercise it is a signal for officers to assemble at the post of the executive officer.

QUARTERS FOR MUSTER AND INSPECTION.

39. (1) **The call for quarters for muster and inspection** will be the *assembly* sounded by the buglers. The divisions will fall in as a whole, in their designated places. Gun-crews, ammunition-crews, torpedo-crews and other groups and units of the powder-division will fall in as units, with gun-captains and leading-men in charge of their respective crews and units.

(2) *Turret gun-crews* and ammunition-crews will fall in with one gun-crew and its ammunition-crew forming one rank, the other gun-crew and its ammunition-crew forming the other rank, gun-crews on the right, with gun-captains and leading-men on the right of their respective crews. (See Plate 1.)

(3) *Broadside gun-crews* will fall in, with the starboard crews forming one rank and the port crews the other rank, the rear rank containing the crews of the guns on the side on which the division forms; the gun-captains on the right of their respective crews. (See Plates 2 and 3.)

(4) The same idea, as far as practicable, will apply to the secondary-battery crews and the powder-division.

(5) The details, from the engineer-division and marines, to the powder-division, will habitually fall in with the divisions from which they are detailed, except that after securing from exercises in which they take part with the powder-division, they will fall in with that division until accounted for and dismissed by the officer of the powder-division.

(6) The Infantry Drill Regulations prescribe that the distance between ranks in all formations shall be 36 inches.

(7) *Gun-captains and leading-men* in charge of crews and units should salute the division-officer as he approaches them at his inspection, and at the same time make report of absentees. The crews and units being small and permanent the muster can be quickly made; there need be no roll-call, as the gun-captains and leading-man can assure themselves of the absentees by a glance along the ranks, or by an inspection from the front or rear.

SHIP AND GUN-DRILLS.

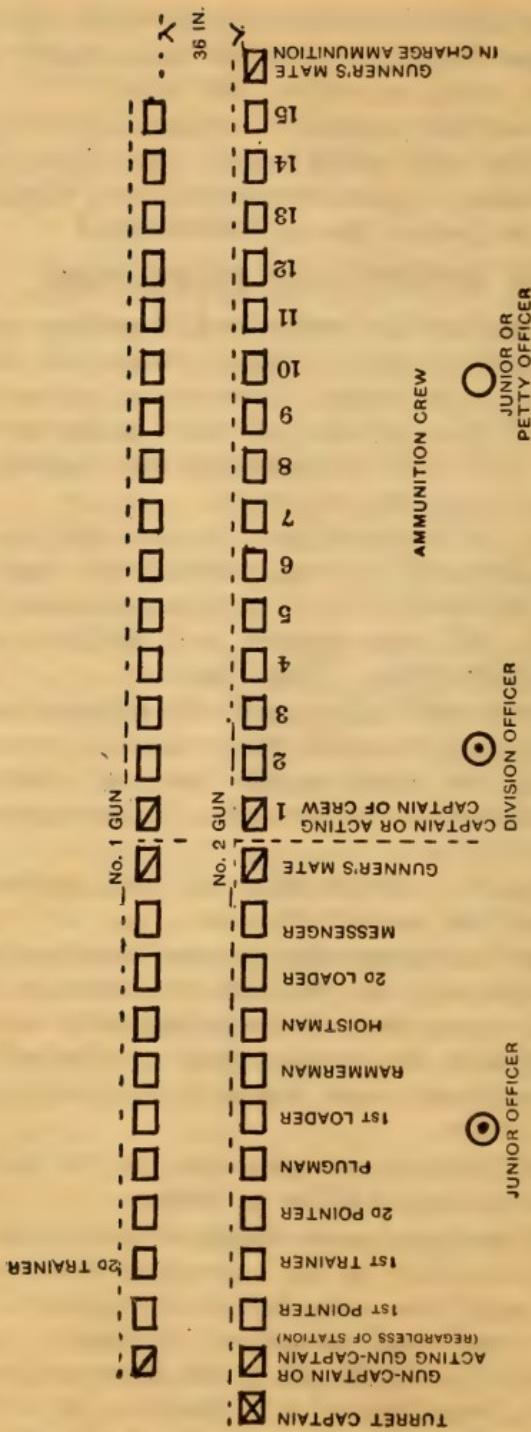


Plate 1. Art. 39 (2).
Quarters for muster. Turret-division.
12-inch turret, Maine class.

Note.—The figure shows the forward turret-division, on starboard side of the deck, facing inboard. Crew, and ammunition-crew, of No. 1 gun in rear rank. Crew, and ammunition-crew, of No. 2 in front rank. Other turret-divisions should form similarly. At inspection by the commanding officer, the division officers will form on the right (or left) of the front rank in order of seniority.

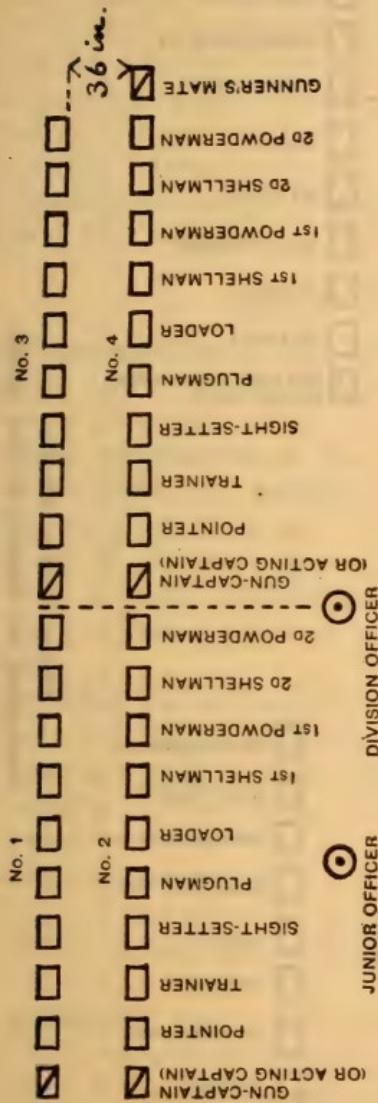


Plate 2. Art. 39 (3).
Division formation. Quarters for muster.

Note.—The figure shows the formation on *starboard* side of main deck for a division composed of four 6-inch, 50-caliber, R. F. guns, Nos. 1, 2, 3, and 4; the ten men on the right of the rear rank form the crew of No. 1; the next ten men in the rear rank the crew of No. 3; the front rank is composed of the crews of guns Nos. 2 and 4, in order from right to left. For a division of more than four guns, the additional crews would be formed in a similar manner. See Art. Formed on the port side the front and rear rank would be reversed. At inspection by the commanding officer, the division officers will form on the right (or left) of the front rank.

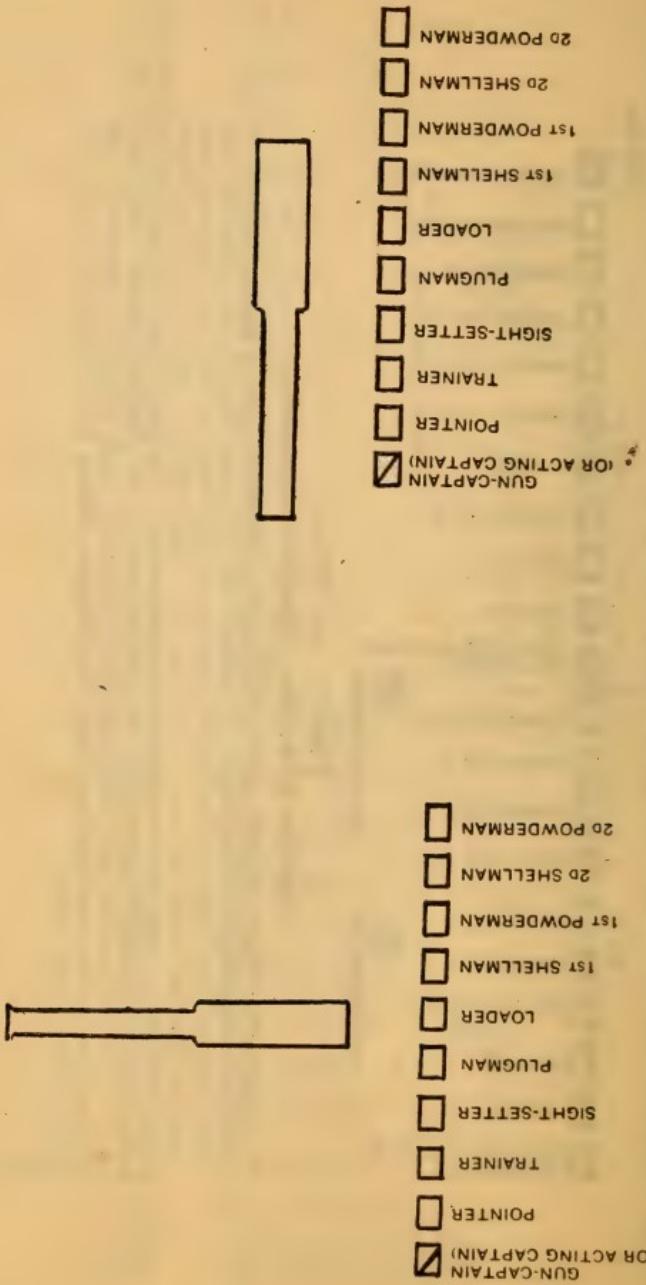


Plate 3. Art. 39 (3).
Formation for muster at the guns.

Note.—The plate shows the crew of a 6-inch, 50-caliber, B. L. R., formed for muster at the gun. The formation is the same whether the gun secures fore-and-aft or athwartships, the gun-captain in all cases being on the right. For guns of other calibers the formations are similar.

40. For inspection by the commanding officer, ranks will be opened, and faced as required, and the division will salute by command of the division-officer, as the commanding officer approaches.

41. (1) For general muster, the divisions, after falling in, will be marched to their designated places, and upon the completion of the ceremony, marched back to division stations.

(2) When orders alone are to be published the command will be *Attention to orders*, and there will be no salute.

(3) When the "Articles for the Government of the Navy," or orders of considerable length, are to be read, the executive officer will command (1) *Parade*, (2) REST! before he begins to read.

DEFINITIONS.

42. **Fixed ammunition** is the term used to indicate that the primer, charge and projectile are fixed in a cartridge-case, forming a complete cartridge.

43. **Separate ammunition** is the term used to indicate that the charge and projectile are separate, although the charge may be in a metallic cartridge-case.

44. **A B. L. R.** is here defined, for purposes of designation and reference, as any breech-loading rifled gun of or above 4 inches in caliber, using separate ammunition without a metallic cartridge-case.

45. **A rapid-fire gun** is a single-shot B. L. R. of greater caliber than small arms, using fixed ammunition, or a metallic cartridge-case, and having a quick-acting breech-mechanism operated by a single movement of the hand, or automatically opened by the gun's discharge.

46. **A semi-automatic gun** is a single-shot R. F. gun in which one operation of the hand is required for each fire, the other operations being performed automatically by the discharge of the gun.

47. **An automatic gun** is one in which, the first shot having been fired by hand, the operations of ejection, loading and firing are performed automatically and continuously by the explosion of the cartridges, so long as ammunition is properly fed, and the trigger held back.

48. **A machine-gun** is a gun of small-arm caliber, from which a continuous rapid-fire can be maintained by operating its mechanism, either by hand or by motor power, causing successively, loading, firing, and extraction of the empty case.

49. **Small-arms** are those fired from the shoulder or from the hand.

50. (1) **Field-guns** are light guns, usually of, or less than, 3 inches in caliber, mounted on field carriages, for operations on shore. When of R. F. gun type, and specially designated as "field," they are usually shorter, lighter in weight, and less in power than ship's guns of the same caliber.

(2) Sometimes they are combined field- and boat-guns, having a special mount for boat use.

PRACTICAL NAVAL GUNNERY.

51. *Excellence in gunnery* is measured by the rapidity of hitting the point of aim. No matter how large a percentage of hits a gun may make, if these hits are not made with the greatest possible rapidity, the gun will have failed to attain its highest degree of usefulness. No matter how great the rapidity of fire, if the gun is inaccurately pointed, it becomes an almost useless weapon. Excellence in gunnery then requires as its two primary essentials : (1) Accuracy of fire, (2) Rapidity of fire.

52. *Accuracy of fire*, in brief, depends upon :

- (1) Accuracy of pointing.
- (2) Correct sight-setting.

53. *Accuracy of pointing* depends upon the individual skill of the pointer,—a skill which is developed; and upon the condition in which the sight, the gun, the mount, and the various appurtenances which affect accurate shooting are kept.

54. *Correct sight-setting* depends upon the accuracy of the orders given by the division-officer, or the gunnery-officer, to the sight-setter, concerning the setting of the sights. This depends upon the accurate determination of the sight-bar range,—the most difficult problem in naval gunnery. Having received the orders, the sight-setter must obey them with promptness and accuracy. As all errors are to be corrected by altering the sights—the pointer always aiming at the same place—it is impossible to attach too great importance to this feature of naval gunnery.

55. *Rapidity of fire* depends upon :

- (1) Rapidity of loading.
- (2) Rapidity of pointing and firing.

56. *Rapidity of loading* is a developed skill. It depends upon :

(1) The rapidity with which each member of the gun-crew performs his allotted duty.

(2) The “team-work” of the gun-crew, which means that each member of the crew must perform his own duty in the service of the gun at exactly the proper time and in exactly the proper sequence, and then get out of the way so as not to interfere with the other members of the crew.

(3) The *precision* with which each member of the crew performs his allotted work in the service of the gun. Accuracy and

thoroughness in every detail, even though it requires slightly more time, is an absolute requisite to *real rapidity in continuous loading*; the commendable eagerness for rapidity may cause serious delays by interference, confusion and casualties, all of which can be avoided by precision in every movement. The raising of a burr, the marring of a thread in the screw-box, the tripping of a shellman with a shell in his arms, may easily cause delays longer than the time necessary to load and fire several shots.

57. *Rapidity of pointing and firing*, depends, like accuracy of pointing, upon the skill of the pointer and the condition of the sights, gun, mount, etc., but particularly upon the condition of the mount and firing-connections. A skillful pointer with an efficient mount and sure connections has his gun aimed and is prepared to fire as soon as notified that the gun is "ready," thus making the rapidity for aimed shots equal to that for unaimed shots.

58. (1) From the above it is apparent that skill in gunnery, measured by rapidity of hitting the point of aim, depends not upon the pointer alone, but upon the efficient performance of his allotted duties by every person participating in the practice. The greatest rapidity of hitting can be attained only by the united efforts of all concerned.

(2) Without efficiency on the part of the gun-crew and the division, all attempts to attain high efficiency for the ship are fruitless. For the guidance of the division-officer, whose duties, as such, are of the very highest importance, these brief notes and outline of duties and requirements are set forth.

THE DIVISION-OFFICER.

59. (1) His chief duty is the development of his gun-division, which in turn requires the development of every individual gun-crew, to the highest possible degree of excellence. Guns, gun-crews and ammunition are placed in his hands, and with these, after a limited period of training, he is expected to hit the target rapidly. With his guns trained to rapid hitting when firing singly, under his control and at known speeds and ranges, he must then develop their efficiency as a group, firing independently, under the conditions of unknown speed and varying ranges, where his individual attention is no longer concentrated on a single gun, but must be divided among them. If he is dependent upon the gunnery-officer and range-finding party for range and lateral compensation, he must see that their orders

quickly reach the gun-captains and sight-setters; if he becomes dependent upon himself for these, he must be expert in quickly bringing the fire of his group upon the target, and keeping it there under rapidly changing conditions. The method to be used by him, in such cases, must be decided upon, and the division trained in its use.

(2) In the accomplishment of these objects there is not a single feature of naval gunnery that he can afford to overlook or neglect; and when he has accomplished these, he may well feel that he has contributed all that he can toward success in the crucial test which is the ultimate object of all training.

60. Practical knowledge.—The best results can be attained only by an officer who has a thorough practical knowledge of all the ordnance material under his charge. This does not mean a general knowledge of how the guns and appurtenances are used; it means the most complete knowledge, especially *practical*, that it is possible for him to obtain. He should know more about every detail of his guns, mounts, sights, ammunition and other ordnance supplies than any other person in the ship. He should render himself thoroughly familiar (both practically and by a study of descriptive pamphlets and other literature) with the construction, use, and means of manipulation of every piece of mechanism of the guns, mounts, and accessories. He should thoroughly familiarize himself with the regulations for the care and preservation of the ordnance outfit, and the precautions to be observed, and should see to it that these regulations are carried out by the members of his division. He must assure himself, by frequent inspections, that the ordnance and all appurtenances under his charge are always kept in the most efficient possible condition; and that mechanical difficulties in the way of accurate and rapid pointing are reduced to a minimum; and if the guns and mounts do not then work with the required facility, it is his duty to recommend such steps toward their modification as will insure their efficient operation. He must see that the sights (open as well as telescopic) are in adjustment with the bore-sights, and not only that they are maintained in as good condition as when supplied, but also that they are sufficiently secured to withstand the shock of discharge without jarring out of adjustment. Similarly, he must see that his firing connections, and connections for night-sights, are strong and well secured; that the firing-mechanism and the batteries are in good condition, and the circuits complete. He should also thoroughly understand the ammunition supply of his

guns, and be prepared to obtain ammunition for his guns in the event of a breakdown in the regular supply system.

61. (1) **Note-book data.**—He should ascertain and record the initial velocity for which each of his sights is graduated and the kind and amount of powder required to give this I. V.; the normal pressure; the pressure which, on the score of safety, should not be exceeded; the mark of the gun and its length in calibers; the sight-radius, the permanent angle of the sight, etc.

(2) He should construct for each gun a table showing the following data for target-practice ranges, for battle ranges, and for long ranges:

(a) The angle of elevation.

(b) The angle of fall.

(c) The time of flight.

(d) The danger space for 17' (height of target).

(e) Drift (in yards) at target remaining uncorrected.

(f) The lateral distance (in yards) at the target that is corrected by one division on the deflection scale, and the amount of drift uncorrected or overcorrected at various ranges.

(g) The lateral effects of the apparent force of the winds of various strength and direction.

(h) The vertical distances at the target, at the various ranges, corresponding to changes of 100 yds. on the sight-bar.

(i) The effect (in yards) on the range of variations of one per cent in the density of the air.

(j) The times of flight of projectile for the various ranges, so that when necessary, fuses may be set accordingly.

(3) He should keep a memorandum of the action of the various indices of powder in connection with known ranges, always entering any reliable data that can be obtained. These data should be arranged in a note-book, in such convenient form that the necessary corrections or allowances for any conditions could be quickly ascertained.

(4) A good pointer will bunch his shots if he aims always at the same place, which, if he points rapidly as well, is all that is required of him; but it is not enough for the gun, and it remains for the division or gunnery-officer to so change the range and lateral compensation that the shots will be *bunched on the target*. He and not the pointer is the *marksman*, hence he must have at his very fingers' ends the data for quickly bringing the shots on the target.

62. (1) To train intelligently his gun-crews to the highest degree of efficiency, the division-officer must himself know every individual duty of every member of the gun-crew, and how such duty can be best performed. He must, in all exercises with the various devices for training the gun-crews, as well as at actual drill at the gun, insist on the careful observance of all the minor details of the drill, bearing in mind that any drill that is carried out without observing every detail which it would be necessary to observe in actual firing, or without striving to attain as great a degree of rapidity as will be sought in target-practice, or in action, is *actually detrimental to the gun-crew*. Gun-crews, when at drill, are too apt to regard small matters as of no consequence, but these are nearly always the causes of delays when it comes to actual firing. Every man should be made to feel that in practicing the small details that are mentioned in the drill-books, he is learning to avoid what some one else learned by actual experience. Owing to the number of gun-crews which may be under the command of one division-officer, each officer should consider it a most important feature of his own duties to develop the junior-officers and gun-captains of the various guns so that they can efficiently instruct and drill their own crews. The principle cannot be too strongly impressed upon gun-captains and gun-crews that every movement at gun-drill should be made quickly, no matter how much time may then be available. No pointer can make a high score in hits per minute unless the gun-crew is capable of continuous rapid loading; and no gun-crew will be capable of loading a great number of times in a minute, unless the members of that crew have been trained, as a team, to do their individual duties quickly, thoroughly, and without interference. Drill is as much for the purpose of training men how to serve a gun *quickly* as how to serve it *at all*; the crew must be *trained* at rapidity of fire, rather than simply *instructed in it*.

(2) *Intelligent rapidity at drill should be such that intelligent rapidity in battle will be mechanical.* At gun-drill the crew is being trained for the one great emergency of battle, and at such time every fraction of a second counts; and the only way to obtain a gun-crew which will utilize to advantage every fraction of a second, in battle, is to train it to do so in time of peace.

TURRET-CAPTAINS.

63. The **turret-captain** is second only to the officers in his authority in the turret, and he must be capable of performing

their duties when they are absent. He must know and be trustworthy to perform the vitally essential duties of receiving orders, directing the setting of the sights and the fire of the guns, adjusting sights, fitting gas-checks, and particularly to enforce the precautions and safety regulations pertaining to loading, firing, unloading, miss-fires, hang-fires, or unforeseen casualties. In the absence of the turret-officer, the turret-captain takes charge, carries out the regular drills, the training with mechanical targets, actual target-practice, or commands the turret in action, in the same manner that the turret-officer would do, were he present. In his daily duties he is charged with the care, preservation and efficient condition of everything belonging to the turret. He should give the necessary orders to the captains of the guns and ammunition-crews, and to the gunners'-mates, and see that the orders are carried out, superintending and assisting with the work when necessary. Repairs, cleaning, overhauling, general work and drill are all under his general charge, and he is responsible to the turret-officer for their thoroughness. Having these general duties, it is indispensable that he acquire a thorough knowledge of the ordnance of the turret, and he should obtain and study the detailed descriptions of every part of it.

GUN-CAPTAINS.

64. (1) **The gun-captain**, in addition to his duties in his individual station at the gun, is in charge of that gun and gun-crew. He must not be allowed to regard his duties as merely perfunctory; he receives extra pay for his services as gun-captain, and should have the same relation to his gun and gun-crew that a coxswain has to his boat and boat-crew.

(2) He is responsible to the division-officer for the good condition of gun, mount and appurtenances, and for the drill of his particular crew. He should have:

(a) A thorough practical knowledge concerning his gun, mount, accessories, ammunition, etc., and the ammunition supply for his gun.

(b) The ability to take charge of, drill and instruct his gun-crew in practical details concerning his gun, without the supervision of an officer.

(c) The executive ability to handle a crew of men, make them perform every detail of the drill, and maintain their parts of the gun and mount in excellent condition.

(3) His duties in the instruction and development of his crew

have to do very much more with the development of its practical skill in serving and firing the gun than with its theoretical instruction. He should, however, be thoroughly familiar with his gun, mount and all appurtenances, and be able to explain such essentials to the crew as will enable them to gain the best practical results from their exercises.

(4) He has immediate charge of the exercises with the mechanical devices provided for training the crew, and should clearly understand their purpose and the object to be attained.

(5) As he is responsible to the division-officer for the practical development of his crew, he should bear in mind that it is his duty to get out of the crew the very highest performance of which it is capable.

(6) The remarks upon rapidity and precision laid down for the guidance of the division-officer, apply in full force to the gun-captain.

THE GUN-POINTER GROUP.

65. The pointer, the trainer, and the sight-setter compose this group.

(1) **The pointer** must remember that he has a most important position. A ship is built for the purpose of using her guns, and she may never be engaged in action more than a few minutes during her whole career; if in these few minutes a pointer, through over-confidence, or neglect of any of the details of training, fails to fire accurately and as quickly as possible after the gun is loaded, he fails in his duty to his ship; he has occupied one of her important positions of offense without doing the enemy the greatest possible injury.

(2) He must always aim at the *designated point*, so that his shots will be bunched in a small area; he has nothing to do with the correction of his sights, or of the fall of the shots, by changing his aim; the range is kept for him by those who are specially detailed for that purpose, and any attempt toward it on his part will produce confusion and error.

(3) Skill is required in order to point the gun in exactly the same manner for each shot, and especially is this the case when the ship is rolling or pitching. Accuracy demands, where the gun is capable of doing so, that the wires be kept on the target, at least during the "firing-interval." If the gun is not capable of continuous-aim, the pointer must be trained to allow for the "firing-interval." Much skill and constant practice are essential with this method. The *quickness* with which the pointer can aim and fire his gun

is a most important factor in his excellence, but in his zeal for rapidity the pointer should always remember that if the wires are not *exactly* "on" when the projectile *leaves the gun*, he will surely miss, and will have actually thrown away the entire time required to load, aim and fire that shot, and will have misled the officer observing its fall; therefore, he must never sacrifice accuracy to rapidity. The firing-pointer must control the pointing of the gun, commanding the trainer *Right, Left, A little faster, A little slower*, etc., as the case demands.

66. The trainer is the second pointer for the gun. He will keep his sight set roughly for the range but exactly for the lateral compensation ordered, and, unless otherwise directed by the pointer, will keep the gun trained continuously on the center of the target, or designated point of the enemy. He must obey the commands of the firing-pointer, even though he thereby throws his own sight off. Pointers and trainers must, both when actually firing, and when exercising, keep their eyes pressed firmly against the rubber guards on the eye-pieces of the telescope, and keep the cross-wires, or the line of sight, constantly on, when it is practicable to do so. With efficient sights, concerted action between the pointer and trainer will be rendered comparatively simple.

67. (1) The sight-setter must keep the sight set exactly as he is ordered (both laterally and vertically), and he must keep the trainer notified as to how the pointer's sight is set. He must carefully watch the sight during firing, to see that it is not jarred from where he set it, by the discharge of the gun. He must realize that, unless at each shot the sight is correctly set, the pointer must certainly miss.

(2) It is forbidden for the pointer to attempt to correct errors, vertical or lateral, by altering his point of aim; therefore, all the greater care must be observed by the sight-setter and the division-officer to have the sights correctly set.

(3) *The more accurate the pointer, the more surely will he miss the point of aim if the sights are incorrectly set.*

68. Deflection-scale.—While the amount and direction in which to move the deflection-scale will always be given the sight-setter by the division-officer, it is important that the gun-captain, and the members of the gun-pointer group, should thoroughly understand the direction the sight must be moved to correct errors made or anticipated. It is simply necessary to remember that the shot always falls in the direction in which the eye-piece of the telescope (or the rear sight) is moved. Every one knows that if

we raise the sight-bar we fire higher; if we lower it we fire lower; similarly, if we move the rear sight (or telescope eye-piece) to the right we shoot to the right, and if we move it to the left we shoot to the left.

FIRE-CONTROL.

69. Efficient fire-control means the accurate control of the sight-bar and the deflection-scale which will quickly bring the shots on the target and maintain them there. The very first essentials are that the pointer shall always aim at the designated part of the target or enemy, that he shall never fire unless his sights are "on," and that the sight-setter shall quickly set the sights exactly as ordered.

70. (1) The elementary training for fire-control is developed at target practice, where guns are fired singly at measured ranges. Here, knowing the speed and the measured range at any moment, and having found the corresponding sight-bar range by trial shots, it remains for the division-officer to give the sight-setter the sight-bar ranges and amount of deflection to insure that every shot accurately aimed at the center of the target will hit it. The officer must, by the use of the deflection-scale, allow for the apparent force and direction of the wind.

(2) With an accurate pointer and steady platform, the first shot of a string should hit; the second and others should surely hit if the corrections were applied from accurate observations of the preceding shot. With proper control the first two shots should always suffice to bring the remaining shots on the target, even with a sight slightly out of adjustment, a pointer with an uncorrected "personal error," or sight-bar range incorrectly established by the trial shots. As a rule, lateral errors may be corrected from the observance of a single shot; in changing the sight-bar setting, however, there should be more hesitation in the deduction to be drawn from a single shot that misses the target in elevation, but after a second miss, with approximately the same error as the first, the necessity for a proper correction of the sight-bar is imperative.

71. The grand tactics of fire-control is where all the guns of a ship's battery are firing together at unmarked ranges and under changing conditions, as would be the case in battle. Here the range is determined by the range-finding party, and transmitted to the battery by the gunnery-officer, through the range-indicators and such other means as may be provided. The correction to the distances given by the range-finding party would be determined

by the gunnery-officer from observation of the position of the center of impact of the shots, and this, and the lateral correction, would be applied by him, and transmitted to the guns, so that with sights set as he orders, the target would become the center of impact. Here again is emphasized the great importance of every pointer being a trained expert, firing only when his sights are "on" the center of the designated target; and also the importance of all the sights being set exactly alike, that is, exactly with the sight-bar range and lateral compensation ordered by the gunnery-officer, though individual guns may apply previously determined constant corrections to the transmitted range. This will cause the shots to be bunched, and the gunnery-officer can quickly make alterations in the sights of the battery that will bring this bunch on the target. Otherwise there would be such dispersion of shots that the gunnery-officer could make no deductions from their fall to guide him in the determination of the error existing between the range as determined by the range-finder and the actual sight-bar range which should be used. Even were range-finders exact in the measurement of distance, conditions are now such that a sight-bar range would nearly always have to be determined. With range-finders which do not exactly measure the actual distance their errors would be quickly seen, and could be quickly applied to the constantly changing conditions of battle. In case the communications from the gunnery-officer to the divisions were interrupted, the division-officer must be prepared to control the fire of his own group, and should do so, on the same lines as above indicated, from a station where he can best observe and transmit corrections to his guns.

NOTE.—Owing to the difference in the effects that time of stowage, temperature of magazines, etc., has on the various indices of smokeless powder, a certain scattering of shots will be observed when all guns use the same sight-bar range, no matter how accurate the pointing. Hence it will probably be necessary, before action, to determine the correction to be applied to each gun and index; or better, if permitted by the Bureau of Ordnance, to bring the charge to the weight which will give the correct range, thus permitting all guns to use the same sight-bar range, and bunch their shots.

PART II
GUN-DRILLS
AND
DETAIL-NOTES

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INTRODUCTION.

The turret, auxiliary and secondary gun-drills incorporated herein were written, tested by actual trial and reported by three separate boards of division-officers (serving in the North Atlantic Fleet in command of guns of the respective types), appointed by direction of the Chief of the Bureau of Navigation for the purpose of recommending the gun-drills which, as shown by the results of actual firing, would, in their opinion, produce the best results in battle.

As these drills have been progressively developed by experienced division-officers, and as it is essential to future progress that this process of improvement in details be not arrested, the drills themselves will not be considered as mandatory in character, and all officers are invited to exercise, in the future as in the past, their ingenuity, not only to improve both form and details, but also to suggest improvements in appliances for more efficiently handling and pointing guns of all calibers—in all cases fully reporting those improvements which the test of actual firing has shown to be of practical value.

No discretion is, however, permissible in the observance of the safety precautions that have been, or that may hereafter be, prescribed by special or general order of the Secretary of the Navy. These precautions must in no case be deviated from in any particular without express permission of the Navy Department, "and further, as there may be situations arising which it would be impossible to cover in advance by rules, officers will be held accountable for the exercise of good judgment in accordance with their professional education and training."

These drills comprise those applicable to all of the principal types of heavy gun-mounts now in service and to the standard and most common types of guns of 6-inch caliber and below, but on account of the numerous types of practically obsolete mounts still in use, particularly of the smaller calibers of guns, and on account of the limitations of space available, the drills for all of such guns have not been inserted herein; but as the drills omitted would in most cases be practically identical with those of guns most nearly approaching them in type, officers will be able, by slight modifications, to adapt them without difficulty to their use.

The notes on gun-drills are the result of actual experience. The precautions specified therein have in nearly every instance been suggested by actual casualties, and the descriptions of the methods of handling the various appliances are derived from the work of experienced division-officers whose recommendations are based upon tests at actual firing. They are given as fully and as minutely as possible, so that officers who are placed for the first time in charge of certain types of guns, particularly those in turrets, may derive the maximum benefit from the accumulated experience of those officers who have achieved the best results.

It should not be inferred, however, that these notes are assumed to be final in any respect; and therefore they are not mandatory (except as to safety precautions). On the contrary, it is enjoined upon all officers concerned to exercise their personal initiative in devising improved methods which, when shown by actual experience to be successful, should be fully reported, no matter how insignificant the improvement in question may appear to be. The same applies to all casualties, whether they are of a nature seriously to retard the operations of the gun, whether their effect is comparatively insignificant, or whether they are simply inconveniences or annoyances, since the accumulation of such defects sometimes has a sensible effect upon efficiency.

The drills themselves are given in as concise a form as possible. With modern guns they are necessarily very simple, being but the skeleton of the duties required, while the notes constitute the real body of the drills, and they should therefore be studied with care.

Those notes that relate particularly to individual drills are inserted in small type in the text of the drills themselves, while those of a general nature that relate to many types are placed before the drills of each class of guns.

Criticisms of these drills are invited, but such criticisms should be complete in detail and should be accompanied by a statement of the relative merits of suggested improvements that are based on actual trial.

SAFETY ORDERS AND PRECAUTIONS.

1. (1) As has been stated already, the drills given herein are of an advisory nature, and may be changed by commanding officers when it is considered to the interests of efficiency; but all orders and instructions looking to increased safety in firing the guns will be scrupulously obeyed. For convenience of reference, these orders and instructions are assembled below, and while an effort has been made to include all instructions relating to necessary precautions of all kinds, still the omission of any details which are included elsewhere in this book, or in other duly promulgated instructions, shall not relieve any person from observance of same. Blank pages are left for the insertion of notes or safety orders which may be issued in future.

(2) The following is a list of Safety Orders relating to the handling of ordnance material, issued by the Department, which remain in force March 1, 1905:

General Orders.

No. 33, dated March 23, 1901.

No. 42, dated April 15, 1901.

No. 44, dated April 29, 1901.

No. 62, dated Oct. 21, 1901.

No. 127, dated April 27, 1903.

No. 160, dated May 26, 1904.

Special Orders.

No. 10, dated Aug. 16, 1901.

Subject.

Directs that only well-crimped cartridges be used in 1-pdr. Maxim-Automatic Guns.

Prohibits the use of full charges of brown powder, except for taking pressures.

Modifying General Order No. 42, stating that it does not apply to guns using fixed ammunition.

Directs that only blind shell be used for 1-pdr. sub-caliber practice.

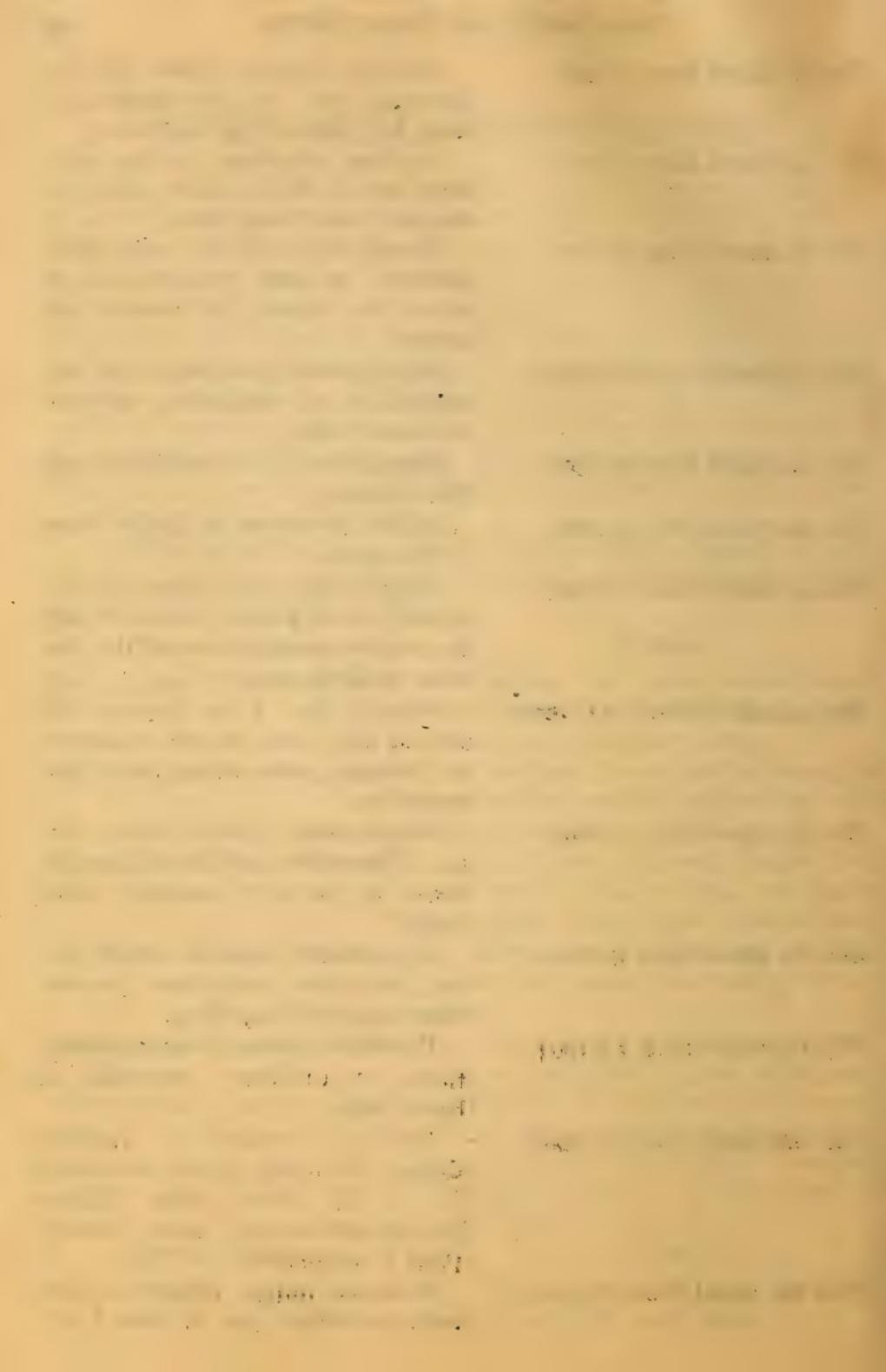
Enjoins care in inspection, preparation and handling of explosives.

Details of accident on *Missouri*. Inviting attention to the danger from the combustible residual gases remaining in the bore of the gun.

Subject.

Directs removal from shells of all base-plugs and fuses.

- No. 11, dated Sept. 7, 1901. Modifies Special Order No. 10, directing that the base-plugs and fuses be removed only on shore.
- No. 22, dated May 2, 1902. Inviting attention to the accident on H. M. S. *Mars* and the danger from hang-fires.
- No. 28, dated Aug. 28, 1902. Directs that B. L. R. using B. L. primers be not primed except when the breech is closed and locked.
- No. 39, dated April 13, 1903. Regulations governing the examination of smokeless powder on board ship.
- No. 40, dated June 20, 1903. Regulations for magazines and shell-houses.
- No. 44, dated Oct. 31, 1903. Invites attention to danger from a flare-back.
- No. 45, dated Nov. 10, 1903. Directs that no fuses be removed from loaded shells except by explicit instructions of the Bureau of Ordnance.
- No. 46, dated Nov. 13, 1903. Directs that force beyond the use of the hand be not employed in loading guns using fixed ammunition.
- No. 57, dated May 31, 1904. Supplements Special Order No. 44. Prescribes additional precautions to be used against flare-backs.
- No. 64, dated Nov. 10, 1904. Supplements Special Order No. 22, prescribes additional precautions against hang-fires.
- No. 65, dated Nov. 15, 1904. Prohibits changes or modifications in ordnance material on board ship.
- No. 68, dated Jan. 25, 1905. Invites attention to possible danger of firing 5-inch or 6-inch B. L. R. fitted with Vickers breech-mechanism, when breech-plug is unlocked.
- No. 69, dated Feb. 11, 1905. Reduces initial velocity of 12-inch 40-caliber gun to 2600 f. s.





SAFETY ORDERS RELATING TO GUNS USING B. L. PRIMERS.

2. (1) Never prime a B. L. R. except when the breech-plug is closed and locked. See Special Order No. 28, dated August 28, 1902, as follows:

"Hereafter the practice of priming breech-loading guns, using B. L. primers, while the breech is open, is to be discontinued, and the breech-plugs must be closed and locked before the primer is inserted in the firing-lock, except in the case of 5-inch and 6-inch, 50-caliber guns, in which the firing-pin is in a safe position until the breech is locked."

NOTE.—In priming these guns with electric primers the method prescribed in detail notes is to be followed, viz.: lock breech to within about $\frac{1}{4}$ -inch of contact, insert primer, close wedge, then revolve plug until contact is made.

(2) Never unlock or open breech when a live primer is in the lock.

NOTE.—Hence, from above rules, under no circumstances shall a live primer ever be in the lock of a B. L. R. except when the breech is closed and locked within $\frac{1}{4}$ -inch of contact. As in the case of Special Order No. 28, 5- and 6-inch, 50-caliber guns, are excepted from this order, as they are provided with automatic safety appliances.

(3) Never hook the lock-lanyard to the trigger of the lock until the breech-plug is closed and locked, and the gun primed. The lanyard should be hooked just before cocking the lock, not after cocking it.

(4) Never unlock or open the breech-plug with the lock cocked or with the lanyard hooked to the trigger.

(5) With guns using B. L. primers, the primer will always be withdrawn from the lock at the command CEASE FIRING! and if a gun-crew leave a gun at any time, the gun will be left in the position of CEASE FIRING.

(6) In loading guns having powder charges made up in bags, in no case will the charge or section of the charge be rammed with force against the shell. If it is to be rammed home, it should be stopped just short of contact with the shell. The rammer should be marked "*Charge Home*," and this mark never exceeded. To forcibly ram a section of a charge against the base of the shell introduces an element of danger which must be avoided.

(7) Actual powder charges will never be used at drill, but dummy charges in all respects similar to the actual charge will be used. In the case of breech-loading rifles in which the charge is made up in a serge bag, the bag, even though covered with canvas, becomes greasy and contains all essentials for spontaneous combustion, especially when stowed in a warm magazine. Rapid-

fire ammunition always contains live primers, and though firing is improbable, it is nevertheless possible; drilling with actual charges is therefore always a source of danger to the crew itself, and, in the case of fixed ammunition, to the neighboring ships.

(8) In view of certain fatal accidents which have occurred in other services, especial attention is invited to Special Order No. 68, dated January 25, 1905, as follows:

"The Department desires to call attention of the officers and crews of ships carrying 5-inch and 6-inch guns having breech-mechanisms of the Vickers Sons and Maxim type to the possible danger of firing these guns as at present fitted with the breech-block swung home, but not rotated. This could only happen in a case where the rotating stud was broken, as sometimes happens, if the plugman were to rotate the hammer of the lock by hand in order to raise the wedge and allow the operating lever to pass it.

"Officers and crews of guns are strongly cautioned against touching the hammer at target practice for any such purpose. If the hammer is found to be in the way, the firing will at once be discontinued till the apparent jamming is investigated. Safety devices and stronger studs will be fitted to these blocks as soon as possible by the Bureau of Ordnance, but in the meantime, a luminous white line 1 inch wide across the upper part of the breech-face, on a vertical radius, continuous only when the breech is properly closed, and a red sector on the breech-plug, invisible only when the breech is properly closed, will be painted on the guns referred to, as a visual signal of danger."

(9) Attention is invited to Special Order No. 69, dated February 11, 1905, reducing the initial velocity of the 12-inch 40-caliber gun as follows:

"It is hereby directed that the initial velocity assigned to the 12-inch, 40-caliber guns, Mark III and Mark IV, be 2600 foot-seconds.

"The Bureau of Ordnance will give instructions regarding the weights of charges to give the initial velocity required, and proceed with the necessary work of graduating all sight-bars for these guns for an initial velocity of 2600 foot-seconds.

"After the receipt of this order no 12-inch, 40-caliber gun will be fired with a weight of charge that is not assembled and properly marked for an initial velocity of 2600 foot-seconds without the authority of the Department."

Primers.

3. (1) The following notes on primers are inserted here for convenience, being taken bodily from the notes on gun-drills.

(2) *The primer should be inserted after the breech is closed and locked, but just before the electric connection is made. This prevents the gun being fired before everybody is clear of the recoil.*

(3) *Using electric firing, should it become necessary to extract a live primer, the plugman starts the breech open so as to break the electric connection, the loader extracts the primer, using great care to avoid firing it.*

(4) Using percussion firing, should it become necessary to extract a live primer after the lock is cocked, the turret-officer will caution the crew and pointer to avoid touching the lock-lanyard, then the designated member of the crew will grasp the handle of the lock firmly with the right hand and pull it directly to the rear until it brings up against the stop; with the left hand unhook the lock-lanyard, keeping the hammer pulled back all the time with the right hand on the handle, drop the lanyard, and, with the forefinger and thumb of the left hand, pull back the trigger; hold it back and gently ease down the hammer with the right hand, twisting all the time to the left (against the hands of a watch) until the handle turns to the left and extracts the primer without allowing the hammer to rest against the firing-pin.

(5) Attention is invited to Department Special Order No. 28, of August 28, 1902, and North Atlantic Fleet General Order No. 4, of February 3, 1903, relating to inserting the primer in guns using B. L. primers. These may be summarized as follows:

(a) Hereafter the practice of inserting the primer in breech-loading guns, using B. L. primers, while the breech is open, is to be discontinued, and the breech-plugs must be closed and locked before the primer is inserted in the firing-lock, except in the case of 5-inch and 6-inch, 50-caliber guns, in which the firing-pin is in a safe position until the breech is locked.

(b) In guns using B. L. primers, the breech will not be opened with a live primer in the lock.

(c) The lock-lanyard will never be hooked to the trigger of the lock except when using the percussion firing-mechanism, and then only after the breech is closed and just before cocking the lock.

(d) The gun-crews should be drilled frequently in the manipulation of the firing-mechanism in order that rapid firing may be attained with safety.

Flare-Backs.

4. (1) Attention is invited to Special Order No. 44, dated October 31, 1903, as follows:

"The attention of commanding officers and of all officers and others in charge of guns is directed to the danger from the issue of flaming gases from the breech of large guns when opened quickly after firing. Instances during recent target-practice have been reported where, upon opening the breech to load, flames have issued forth of such volume and temperature that the hair and clothing of members of the gun-crew were singed and scorched. This was observed to be specially liable to occur when firing to windward in a strong breeze."

"Whenever the conditions are such as to create a probability of accident from this cause, the commanding officer and those in charge of the gun will carefully guard against accidental ignition of the powder-charges in the vicinity of the gun; and in turret-guns, when firing into the wind, special caution must be observed not to hoist a charge for the next round above the turret floor until the breech is open and danger by flames from the breech has disappeared."

(2) *When firing both guns of a turret while using the present powder, which leaves a combustible, gaseous residuum, the breech of the gun fired will not be opened while a powder-charge is exposed in the operation of loading the other gun.* This note does not apply to turret-guns that are fitted with a thoroughly-tested and officially-approved apparatus for expelling gases from the bore of the gun.

(3) Referring to the particular danger of a flare-back when firing *to windward*, subsequent experience has demonstrated that while the danger of the flame blowing *back into the turret* is undoubtedly greater when firing *to windward*, the danger of a premature ignition of the charge that is being loaded is greater when *firing to leeward*.

(4) In the first case the wind blows the gas back into the turret immediately, thereby clearing the bore, whereas when firing to leeward the burning gas remains in the bore an appreciable length of time, and may finally come out at either the breech or muzzle. Under these circumstances special precautions should therefore be taken to be sure that the bore is clear of gas. The installation of a device for blowing out the bore will avoid this danger, but the powder-charge should never be hoisted to the loading position without first examining the bore to see that it is clear. With an efficient blower this will entail no loss of time in loading.

(5) Attention is invited to Navy Department Special Order No. 57, dated May 31, 1904, giving in full the precautions necessary to guard against flare-backs. This order is copied *in extenso* in Art. 107, Par. (4) of Part II, and its repetition here is unnecessary.

(6) *Flare-backs with rapid-fire guns* are of infrequent occurrence, and no special precautions against them are necessary with guns in which the powder-charge is completely protected by a brass cartridge-case.

SAFETY ORDERS RELATING TO R. F. GUNS.

5. (1) Hotchkiss R. F. guns may be recocked without opening the breech, by revolving back the operating lever through the

first part of its throw, but especial care must be observed not to turn it back farther than necessary to recock.

(2) Especial care will be observed in the use of electric firing-pins which do not house automatically. When the protruding pin is struck (which is not an infrequent occurrence) it is sometimes bent over and cannot retract. This may not only cause a miss-fire electrically, but when combination primers are being used, there is great danger of firing by percussion before the breech-plug is completely locked.

(3) *When firing blank charges*, empty cases must not be returned to boxes containing charged cases, for if there is any loose powder in the bottom of the box it might be ignited with disastrous results. The best method is to place cases that have just been fired in a bucket of water and knock out the caps. This also expels all dangerous gases from the cases.

(4) The cartridge, or (in the case of separate ammunition) the cartridge-case, will always be removed from a R. F. gun at the command CEASE FIRING! A gun-crew will never leave its gun without first bringing it to the CEASE FIRING position.

(5) Attention is invited to Navy Department Special Order No. 46, dated November 13, 1903, referring to the use of undue force in loading rapid-fire guns, as follows:

“As a measure of safety, the Department directs that force beyond the use of the hand be not used in loading guns using fixed ammunition.

“If at any time it is found that the cartridge-case does not freely and fully enter the chamber of the gun, it should be carefully extracted and put aside to be turned into store at convenient opportunity, being properly marked to indicate its condition.”

MACHINE-GUNS.

6. (1) At the command CEASE FIRING! the gun will be placed in a safety position. The crew will clamp it and stand clear. Never leave the gun with a cartridge in it. The officer in charge of a machine- or automatic-gun will assure himself by personal inspection that all cartridges are out of the gun and its mechanism.

(2) Attention is invited to General Order No. 33, dated March 23, 1901, which calls attention to the danger incurred in using, in the Maxim-Automatic 1-pdrs., cartridges which are not well crimped. Attention is also invited to par. (7), page 367.

U. S. MAGAZINE RIFLE.

7. (1) Before and after all drills or exercises with the rifle open the chambers and inspect the pieces to see that none are loaded.

(2) Never point a rifle, loaded or unloaded, at any living object unless it is desired to kill it.

(3) Never point a loaded rifle in any direction where it could do any damage if it went off,—remembering the long range of the service rifle.

(4) Never load a rifle at practice until ready to commence firing.

(5) At practice, watch the danger-signals carefully to avoid casualties.

(6) Never carry a rifle with a cartridge in the chamber except in exceptional cases, which must be specially ordered by the officer in charge.

(7) In short, every individual man must at all times observe the greatest care in handling the rifle, and as rules cannot be laid down to cover all cases, the common sense of each rifleman must govern him in cases not covered by regulations. He must at all times remember the long range and high power of the rifle, and should never fire it when danger would accrue from either a direct or a glancing shot.

PISTOLS.

8. (1) Never point a pistol, loaded or unloaded, at any living object unless it is desired to kill it.

(2) Never point a pistol in any direction where any damage would result if it went off.

(3) Never touch the hammer or trigger when the pistol is not pointing up or at the object.

(4) Never carry a pistol in the hand or in a holster unless there is an empty chamber under the hammer.

(5) With the exceptions noted in (4), never carry a partially loaded revolver; if it is loaded at all, it should be ready to fire on first trial.

(6) Remember that nearly all accidents occur with pistols "that were not loaded;" each person is required at all times to observe care that, in case of the discharge of a pistol in his hands, no damage could result either in direct flight or from a glancing shot.

(7) At practice, never load a pistol until at the firing point and ready to fire.

MAGAZINES.

9. (1) Doors and flaps to turret-magazines shall always be kept closed. Not more than one charge for each turret-gun

will at any time be exposed in the handling-room. Doors and hatches leading to other magazines will be habitually kept closed when powder is not actually being passed in or out.

(2) Never enter a magazine containing powder outside of its tanks, without wearing magazine shoes.

POWDER AND PROJECTILES.

10. (1) Attention is invited to Special Order No. 39, dated April 13, 1903, prescribing approved methods of examination and stowage of smokeless powder on board ship. This order is too long for insertion but is none the less important, and must be carefully observed in every detail.

(2) Attention is also invited to Special Order No. 40, dated June 20, 1903, prescribing regulations for powder-magazines and shell-houses. Though this order does not apply on board ship, much valuable information concerning treatment, care and precautions necessary with smokeless powder is contained therein.

(3) Attention is invited to Special Order No. 45, dated November 10, 1903, prohibiting the removal of fuses from loaded shell, as follows:

"The Department directs that hereafter no fuses be removed from loaded shell, except by explicit instructions from the Bureau of Ordnance."

(4) Attention is invited to General Order No. 127, dated April 27, 1903, enjoining especial care in the inspection, preparation and handling of all explosives.

MISS-FIRES AND HANG-FIRES.

11. (1) Attention is invited to the chapter on miss-fires and hang-fires, Arts. 101, 102, 103, and 104, Part II.

(2) The safety precautions relating to miss-fires and hang-fires may be summarized as follows:

(a) After a miss-fire wait 20 minutes before opening breech, unless extraction of primer shows that the primer itself failed to fire.

(b) In extracting or inserting primers in a B. L. R. after a miss-fire, a tool should be used with turret-guns, and no one should be in line of the vent during the operation.

(c) After a miss-fire keep the gun pointed in a safe direction until extraction of primer. If then it is discovered that it was a primer-miss-fire, there is of course no danger.

(3) The following special order (No. 22, May 2, 1902), together with the fact that in the U. S. Navy hang-fires of 7 minutes' du-

ration have been observed, accentuates the importance of a strict compliance with these rules.

"The recent accident on board the British battleship Mars on April 14, whereby two officers and nine of the crew were killed and seven men were wounded, due to the unlocking of the breech-plug of a 12-inch turret-gun after a hang-fire, was of such an appalling character that it seems proper to call the attention of the service to the necessity of exercising the utmost caution and prudence in all cases where a hang-fire takes place, in order that the possibility of an accident due to such a cause will be reduced to a minimum.

"While it is not practicable to prescribe a definite length of time which should elapse before the breech of a gun can be safely opened after a hang-fire, no risk should be incurred in time of peace."

(4) Attention is invited to Special Order No. 64, dated November 10, 1904, supplementing Special Order No. 22, as follows:

"1. The possible danger of a serious accident, due to opening the breech too soon after a hang-fire, requires the constant exercise of the utmost prudence and caution whenever a miss-fire occurs.

"2. When a gun-pointer presses the firing-key or pulls the lock-lanyard and the gun fails to fire, a hang-fire must be regarded as probable, and until examination of the extracted primer discloses the fact that the primer itself failed to fire, no distinction can be made between the case of a miss-fire due to failure of the primer to ignite, and a miss-fire due to failure of the charge to ignite after the primer has functioned properly.

"3. It is therefore directed that during times of peace, whenever a miss-fire occurs in any gun from 1-pdr. to 13-inch inclusive, an interval of 20 minutes after the last effort to fire must be allowed to elapse before the breech of the gun is opened, unless, in the case of guns using breech-loading primers, an examination of the extracted primer shows that it did not fire. In such case there is, of course, no danger from a hang-fire, and the above rule would not apply.

"4. Nothing in this order shall be construed as discouraging any possible efforts to fire the gun which do not involve opening the breech. The primer should be removed from breech-loading rifles (using an appropriate tool to avoid danger of being struck by the recoil or injury from a blow-back) and a new one inserted and fired, using either electric or percussion mechanism as most desirable, and these efforts should be continued as long as there is a reasonable chance of firing the gun. Rapid-fire guns—that is, guns using cartridge-cases and fixed primers—will be tried again, either by electricity or by percussion, or by both, whenever this can be done without opening the breech.

"5. In time of war, where the possible chances of serious danger due to miss-fires may be overbalanced by the more important considerations of battle, the commanding officer may, at his discretion, decide what interval shall intervene between the occurrence of a miss-fire and the opening of the breech."

NOTES ON DRILLS FOR MAIN-BATTERY GUNS.

Main-Battery guns are those of 4-inch caliber and above.

Secondary-Battery guns are those of less caliber than 4-inch.

NOTES FOR INSTRUCTORS.

12. (1) The following notes apply to all drill-instructors, whether division-officers, turret-captains or gun-captains.

(2) *The duty of an instructor* is to impart a sound knowledge of the gun, mount and drill. Practical results are sought, not theory. He should therefore avoid reciting copious notes and details to an inexpert crew. The first thing is to get the framework of the instruction into the men's heads, then they can gradually build up the details. A crew should always understand *why* each detail of the drill is done. They should understand first that *Cast Loose and Provide* is simply the command to get the gun ready to fire, and that everything necessary to actual firing must then be done. After the gun is cast loose, the most important operation the crew has to perform is that of rapidly loading the gun, and the pointer-group that of aiming and firing as quickly as possible.

(3) This being thoroughly understood by the green crew, then special drills to develop excellence in loading, sight-setting, pointing, communication, etc., are in order. During this portion of the drill the instructor should explain in simple terms the gist of notes bearing on the drill, giving reasons for the various features, precautions, etc.

(4) When the crew is drilling as a whole, the instructor should command SILENCE! when he corrects any mistake, so that the entire crew may have their attention drawn to the error committed. CARRY ON! will be given as a signal for them to resume the drill. On no account, however, during the performance of any single operation, such, for example, as loading, should a gun-crew be stopped in order to correct mistakes or make remarks. The time to point out mistakes and make necessary observations is after the operation in question has been completed.

(5) Instructors are to differentiate clearly between the operations of the crew proper and of the gun-pointer group, also the difference between merely going through a drill to familiarize a green crew with the various details and going through it with the rapidity and precision necessary to expertness.

(6) During the early stages of drill, never give the complete details for any operation from beginning to end. The individual details should each be thoroughly explained by the instructor, and a reason given for everything that is done, in order that the men may acquire a knowledge of the best and quickest way to perform their allotted duties, and learn from him the numerous small details necessarily omitted from drill-books, but which his experience should readily supply.

13. **Nomenclature.**—With new men the instructor should first inform them of the number of men required in the crew, show them exactly how the gun works, and instruct them in the correct nomenclature of the principal parts of gun and mount. The names of the less important parts will come gradually. The instructor will allow no misuse of terms such as calling a "worm-wheel" "a worm," or a "pinion" a "worm-wheel," etc.

STATIONS.

14. (1) The various members of the gun-crews are simply assigned to stations, instead of numbers, at the guns.

(2) This change was considered desirable in order to avoid the effort to connect numbers and stations. Owing to the small number of men now composing gun-crews, the value of numbers, so necessary with the large crews formerly used, disappears. The titles of the gun-stations are in a general way explicative of the duties, but there is nothing in a number to indicate what duty is to be performed.

(3) Turret-crews form for muster as directed in the chapter entitled "Organization."

(4) Crews of guns not mounted in turrets also form for muster as directed therein. When ordered to fall in at their gun, the gun-crew forms inboard of it (whether it secures fore and aft or not) in line, single rank, facing inboard in the following order, beginning on right:

Gun-captain (or acting gun-captain), pointer, trainer, sight-setter, plugman, loader, shellman.

(5) When the gun-captain performs the duties of another station, as is usually the case, he will nevertheless, after forming and mustering the crew, take his station on the right. This formation at the gun is assumed in the case of all guns not mounted in turrets, whenever the crews are ordered to fall in at their guns, and after securing.

COMMANDS.

15. (1) Officers and instructors will be particularly careful to give their commands in a uniform and distinct manner, laying stress upon the more important words. When an object is designated at which to fire it should be very clearly and distinctly specified.

(2) The following commands are used with all guns of the main or secondary-battery:

(a) CAST LOOSE AND PROVIDE! LOAD! (Designating the object, bearing, range, and deflection); COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE! The details performed at each of these commands is fully explained under the various gun-drills.

(b) The commands STATIONS! SILENCE! CARRY ON! and CHANGE STATIONS! are also used as explained below.

16. STATIONS! At this command, if given when crew is formed for muster, the members of the gun-crew will at once leave the places taken at forming for muster and will take their respective stations at the gun. This command may be given at any time. In whatever position or formation, it means simply that the crews go to their stations for loading, stand up and maintain silence.

17. (1) SILENCE! may be ordered at any time, and at this command every operation will cease instantly, each man will stand in his tracks, maintain silence and await orders.

(2) Any member of a gun-crew who observes anything wrong that requires immediate attention shall call out SILENCE! at which the crew will cease all operations and stand in their tracks, maintaining silence. The man who calls SILENCE! will point out what he has observed, to the division-officer or the gun-captain.

18. CARRY ON! At this command the members of the crew will resume the operation in which they were engaged when the command SILENCE! was given.

19. (1) CHANGE STATIONS! The pointer and his sight-setter, and the trainer and his sight-setter in turrets, and the pointer and trainer of broadside guns should frequently relieve each other. In making the change in guns of the intermediate battery, it is advisable for the pointers to pass underneath the breech of the gun, to avoid interference with the operation of loading, care being taken not to foul the firing-circuit.

(2) Should the trainer become disabled, the sight-setter takes his place, the pointer setting his own sight. If the pointer is

disabled, the trainer takes his place, and the sight-setter replaces the trainer. If the plugman is disabled one of the shellmen, who has been previously designated and trained, will relieve him.

(3) The gun-pointer group of all guns must be thoroughly drilled in pointing and training. The other members of the crew are trained for their special duties; and in case of casualties to any members of the crew, their places should preferably be filled by men of corresponding stations from the unengaged battery, or in the case of turret-crews on the midship line, from the ammunition-crew. It is, however, considered of advantage, after expertness has been attained in individual stations, occasionally to change stations so as to allow each member of the crew to become as familiar as possible with the duties of other members, as in that way the "team work" may be increased. It is of importance that each member of a gun-crew be trained so that he can efficiently perform the duties of two stations at the gun.

NOTES ON CASTING LOOSE AND PROVIDING.

20. (1) *No gun will be considered properly cast loose until all necessary arrangements have been made which will enable it actually to open and maintain an accurate fire on the enemy. At night this includes such necessary special preparations as providing and connecting up battle-lantern, night-sights, etc.*

(2) At CLEAR SHIP FOR ACTION the guns are cast loose without further command, and many preparations are made for action which in general quarters are omitted.

(3) When the ship is not cleared for action, at the call for general quarters, the command CAST LOOSE AND PROVIDE! will include such preparations made at CLEAR SHIP FOR ACTION as enter into the *exercise* of the gun-crews—for example, as the gun-crews should be exercised at *Fire in Action*, the fire-hose will always be led out. As guns must be capable of training freely, all ship-gear or equipment interfering therewith must be removed. Duties performed at CLEAR SHIP FOR ACTION which do not directly affect the *drill of the crew* will not be performed when casting loose for exercise. Such general duties as closing hatches, removing chests and other movable articles, etc., need not be done; such spare parts as are ordinarily kept in the storerooms and provided at CLEAR SHIP FOR ACTION, need not be provided at general quarters for exercise, but will be obtained from the storeroom when required during the drill.

21. (1) Every gun using breech-loading primers will, before reporting ready, actually fire a primer by the mechanism which is to be used. This is a test of the firing-mechanism, and also serves to clear and dry the vent.

(2) The men who, throughout the drills of guns using breech-loading primers, are required to provide themselves with primers, will either equip themselves with a belt fitted for carrying them, or they will provide at a convenient place the box in which primers are supplied. In turrets, for example, racks fitted to carry primers are usually most convenient, as their position in relation to the guns is always the same, whereas with broadside guns expedition requires that the primers be carried by the plug-man.

22. **Tompion to be removed.**—Particular care will be observed by the gun-captain to assure himself by personal inspection that the tompion is out of the gun before reporting ready.

23. **Ammunition-cars.**—When casting loose turret-guns, the ammunition-cars are to be loaded and the signal given to the turret when a car is ready for hoisting. The ammunition for the next round is then to be prepared, ready to go into the car.

24. **The number of rounds of ammunition** to be brought to every gun as a first supply will be regulated by the commanding officer of the ship, and will depend upon the requirements at the time. In the absence of orders, or for exercise at general quarters when the guns are not to be fired, two full rounds for every main-battery gun, and one full box for every secondary gun, will be supplied before the division is reported ready.

25. **Drinking-water.**—The former custom of supplying drinking-water in division-tubs for gun-divisions is considered no longer necessary, owing to the probable duration of a modern naval action, nor is it any longer practicable in our new ships, owing to the numerous subdivisions of the battery.

26. (1) **Priming-wire, etc.**—In the detail drills the expression "sees priming-wire, boring-bit, and vent-cleaner in place and ready for use," will be construed to mean that these articles are to be put in a previously designated place, where they are easy of access, and that they are in a condition to be used immediately on picking them up.

(2) "**Sees bristle- and marine-sponges ready for use**" means that the bristle-sponge will be prepared to be used quickly if required, and that marine-sponges should be placed in gun-tub ready for use.

(3) "Sees lock-lanyard ready for use" means that the lock-lanyard will be examined and conveniently placed in a previously designated position so that it can be picked up, led out and hooked in the shortest possible time. *The lock-lanyard will never be hooked except when the breech is closed and locked.* It may, however, be led out in turrets in casting loose, and should be, if this will save time.

27. Lock screwed home.—When the plugman examines the breech-mechanism he will be particularly careful to see that the lock is screwed entirely home on the mushroom-stem.

28. Material for cleaning lenses.—In all guns using telescope-sights, the sight-setter will, at CAST LOOSE AND PROVIDE, obtain from the gunner's-mate suitable material for wiping the lenses, and at SECURE! he will return this material to the gunner's-mate. No other than the specially provided material will be used for wiping lenses; and, as stated in notes on telescope-sights, lenses will be wiped, even with this special material, only when absolutely necessary.

29. (1) Difficulty in opening the breech and in elevating or training guns is frequently caused by burrs on the diagonal teeth of the breech-plug, or on the worm-gearing of the elevating-or training-mechanism.

(2) Undue difficulty of elevating or training any of the more recent gun-mounts is due to some defect in the individual mount itself and not in the design. Frequently this difficulty is caused by a shaft being slightly bent or out of alignment, and can usually be discovered if searched for progressively.

30. In the compilation of detail drills, in order that all duties may be provided for, it is necessary to insert duties which are rarely essential, such, for example, as clearing the vent, etc. It should be clearly understood that such duties are to be performed only when circumstances render them necessary, since, especially in the above example, they are frequently productive of injurious effects.

31. Notes on ordnance outfit.—(1) Each officer should, soon after joining a ship, make a thorough study of the ordnance allowance book, and especially such portions of it as relate to his own division.

(2) Gun-swabs made of rope-yarn and marled are supplied by the Bureau of Ordnance. The marling should be cut and they should be spread out under the breech of a gun when it is being washed out, to protect the deck. These swabs can also be advan-

tageously used under the breech of small rapid-fire guns when exercising with drill-cartridges, but they should never be used if they would act as obstacles to the efficient service of the gun.

(3) **Recocking tools** are now supplied for nearly all small rapid-fire guns, in order that guns may be recocked after a miss-fire, without opening the breech.

(4) **Marine-sponges and gun-tubs** are supplied only for guns of the main battery. Guns of the secondary battery (except 3-inch R. F. guns) will provide deck-buckets filled with fresh water, and an ordinary ship's hand-swab, instead of a marine-sponge. 3-inch R. F. guns require a gun-tub for washing out after firing, and for cleaning cartridge-cases.

(5) **Dummy charges** of wood are supplied, but as these are so stiff and smooth that they do not reproduce the actual conditions of loading, they should, when possible, be replaced by dummy charges improvised on board, by filling spare powder-bags with small hard objects representing the powder-grains. More efficient dummy charges will doubtless be supplied in future, but under no circumstances will actual charges be used for drill.

(6) **Cutlasses** are supplied for the use of chief petty-officers on ceremonial occasions, such as going in charge of a guard-boat, parades on shore, etc.

(7) **The following receptacles for water** are supplied by the Bureau of Ordnance:

(a) *Galvanized iron buckets*. These are for general use incidental to the ordnance outfit, and are not for drill purposes.

(b) *Copper-bound buckets* for magazines. These are to be filled with water at CLEAR SHIP FOR ACTION and to be kept in magazines, shell-rooms, and handling-rooms for immediate use in case of fire. If water-cans are not provided, these buckets will be filled with fresh water which may be used both for drinking and as a precaution against fire.

(c) *Gun-tubs*. One is supplied for each gun of the main battery, using B. L. primers, and they are to be filled with fresh water at CLEAR SHIP FOR ACTION. This water is for sponging off mushroom-head, and washing out screw-box with marine-sponge. Also, in case of 5-, 6-, and 7-inch B. L. Rs., for wetting sponge of combined sponge and rammer. One gun-tub is supplied for every four rapid-fire guns of and above three inches in caliber. These are not for use at drill,

but are for washing out the bore and cartridge-cases after firing.

(d) *Copper-bound water-cans* are for use in magazines, shell- and handling-rooms. At CLEAR SHIP FOR ACTION, they will be filled with fresh water for drinking purposes.

NOTES ON LOADING.

32. Before loading each round in a heavy gun, a designated number will look through the bore and report "Bore clear." This inspection is to guard against the failure to remove the tom-pion before the first round, and also to insure that no foreign material has been left in the bore. The most available member of the gun-crew will be designated for this duty.

33. (1) In ramming home the projectile of all guns, it is most important that the rifling should bite into the rifling band, and thus prevent the shell slipping back when the rammer is withdrawn. To insure this, power-worked rammers are to be sent home at full speed, and with hand-rammers the whole weight of the body is to be thrown into the operation of ramming home, bringing the shell up with a "bang." The proper seating of shell can usually be determined by the sound, but when rammers are used they should be marked to indicate when the shell is home. Aside from the danger of the shell slipping back, the initial velocity is changed if it is not well seated.

(2) *Coating the shell with vaseline* has been resorted to by many officers to facilitate seating it securely. This applies alike to turret-guns or guns of the intermediate battery. With turret-guns the vaseline relieves the strain on the rammer, and when it has been used trouble with the rammer has rarely been experienced.

34. (1) In loading powder-charges of two or more sections, as for example the 12-inch and 13-inch charges, different methods of loading are necessary, depending on the gun. With the 13-inch, 35-caliber gun, several seconds are saved if the first two sections are rammed just inside of the gas-check seat, then shoved home by the last two sections. In the 12-inch, 40-caliber, which has a reduced breech-opening, time is saved by ramming the first two sections nearly home, then ramming the last two sections just clear of gas-check seat. *In no case will the first two sections be rammed hard up against the shell*, as an unnecessary element of danger is introduced thereby without any accompanying advantage. In guns of this class, rammers should be marked "*Charge Home*" and this mark never passed.

(2) Great care should be taken that the last section of the charge is placed so as to be close against the vent when the breech is closed. With mechanical rammers an expeditious and efficient manner of accomplishing this is to fit a stop on the rammer which automatically arrests it in exactly the proper position.

(3) Care should be taken in loading all guns to insert the charges tie-end forward. For this reason, it is essential that charges be placed in the ammunition-cars in the same manner.

(4) Care should be observed in the handling-rooms never to send up a powder-bag that is torn or broken, however slight the rent, as it is very likely to be ruptured in loading, and spill powder in the screw-box.

(5) **Hand-loading.**—In turrets fitted with the old type of rammer, which is very slow to withdraw, loading the charge by hand has been successfully used by a large number of officers. This method saves much time where the rammer acts too slowly.

Miscellaneous Notes on Loading Guns of the Main Battery.

35. (1) Though the ammunition-crew is in immediate charge of a junior-officer, the turret-officer should supervise the organization of the ammunition-crew and should frequently be present at drill in order to assure himself that the ammunition is handled as expeditiously as possible and with strict regard to safety.

(2) The senior man in each ammunition-crew will act as captain of that crew.

36. An ammunition-crew (total of 30 men for both guns) for a 13-inch gun of the Alabama class can, with considerable exertion, deliver a shell and charge about every 30 seconds. The end in view is to keep a shell in the car, one on the bearer and one in the tongs; a charge in the car, and, as soon as that starts up, a section in the arms of each outside powderman. With an ammunition-crew standing ready, a car can be loaded in a very few seconds.

37. Primers will not be inserted in the lock of a B. L. R. until the breech-plug is closed and locked, except in guns like the 5- and 6-inch, 50-caliber guns, in which the firing-pin is in a safe position until the breech is completely locked. In the case of a B. L. R. using electric primers, the plugman closes the breech and turns the plug until it is within about $\frac{1}{4}$ of an inch of making contact. The primer is then inserted, and the plug completely locked. If using percussion primers, the plug is completely locked, primer inserted, lanyard hooked, and lock cocked.

38. The pointer of a heavy gun should begin to point (in elevation) as soon as he hears the plug-tray take against the face of the breech. The gun should be kept trained on the target at all times during the loading.

39. Loading-tray.—Every precaution must be taken to prevent injury to the gas-check seat and screw-box. To this end, either an automatic or a hand loading-tray must be used, except with fixed ammunition, both when loading and unloading the gun. The tray will be used whether loading with service shell or with drill shell. Many ships have improvised automatic loading-trays. In such instances, that portion of the drill which relates to the handling of the loading-tray will be omitted or modified, according to circumstances.

40. Electric contact.—In all turret-guns, a member of the crew, preferably the man who handles the loading-tray, should be specially instructed to examine at each round the electric contact in the attachment-lug, and assure himself that it is clean, and free from grease or oil.

41. Ammunition-boxes and powder-tanks.—In the case of intermediate-battery guns, the cartridges must be unboxed, or charges removed from powder-tanks, at certain designated points. In action it is best to throw empty ammunition-boxes or powder-tanks overboard. If this is impracticable they should be placed as remote as possible from the guns and ammunition passages.

42. The shellmen for rapid-fire guns must each provide himself with a sharp knife for cutting the lashings on the boxes, and a bunch of waste for wiping off the cartridge-cases before insertion in the gun.

43. Before target-practice, ammunition should all be gotten up, thoroughly cleaned and tried in the gun, and when this has been done the providing of waste for the shellman is unnecessary. Before an action, or at least at intervals during a war, this would also probably be done, but at any time when actual firing is to take place, if the cases to be used have not been specially cleaned and wiped off, the shellmen must provide themselves with waste, and if necessary wipe off the case as soon as it is removed from its box. Care must, however, be taken to prevent waste from falling into the screw-box. Jamming of the breech-plug has been caused by the non-observance of this precaution.

44. Some cartridge-cases of R. F. guns which use separate ammunition are covered on their forward ends with shellac. This

sometimes flakes off and causes the case to jam. Shellac should therefore be scraped off before using such ammunition.

45. Use of undue force in loading.—The following order was issued by the Navy Department, November 13, 1903:

"As a measure of safety, the Department directs that force beyond the use of the hand be not used in loading guns using fixed ammunition.

"If at any time it is found that the cartridge-case does not freely and fully enter the chamber of the gun, it should be carefully extracted and put aside to be turned into store at convenient opportunity, being properly marked to indicate its condition."

46. In rapid-fire ammunition, the shell occasionally starts from its seat in the neck of the cartridge-case. When this is observed the shellmen should put the charge to one side until the shell can be reseated in the case by the gunner's-mate of the division, for if the shell is seriously out of place, the plug will not close. At target-practice the ammunition to be used will be examined before the run, but in action, where the charges come directly from the magazine, the examination of every shell by the shellman who unboxes it is necessary before it is inserted in the gun.

47. Sponging during firing is never necessary with smokeless powder, but the use of a combination sponge and rammer is required with all broadside breech-loading guns. See Special Order No. 57 of May 31, 1904 [Art. 107, (4)].

48. (1) Gas-check and gas-check seat.—As it is imperative that the gas-check and gas-check seat be kept thoroughly clean during firing, they are wiped off with a marine-sponge after every round. The screw-box and gas-check seat should be wiped out after withdrawing the loading-tray, as dirt may be deposited while loading.

(2) Though the marine-sponges are supposed to be placed in the gun-tub, many officers prefer, owing to the size of the tub, to use a bucket for this purpose, retaining the water which is in the gun-tub as a reserve supply. When using the combination sponge and rammer, the use of the gun-tub is more convenient, as the sponge should be thoroughly dampened in order to avoid all possibility of any fire remaining in the chamber.

(3) With rapid-fire guns using smokeless powder, the use of fresh water or marine-sponges is unnecessary, hence the drill does not require that these articles be supplied. If, however, actual firing is contemplated, a gun-tub filled with fresh water will be provided by the gunner's-mate, together with necessary sponges for cleaning the gun immediately the firing has ceased. At CLEAR SHIP FOR ACTION these will always be provided. This providing of water which is unnecessary at *drill*, but which may be necessary

in action, is thus considered a portion of the preparation for action, but not for gun-drill in itself.

49. The prompt and regular supply of ammunition is essential to efficiency, therefore actual exercise in that feature is as necessary as is exercise at the gun. Rapid loading, without a corresponding rapid ammunition supply, is without value, and this supply includes every operation from taking the ammunition from the magazine, unboxing it, to inserting it in the gun. Especial attention should be given to providing for the disposition of cartridge-boxes or powder-tanks in such a manner as to least interfere with rapidity of serving the gun. If they are to be thrown overboard in action, a special drill should be devised which will accomplish this object with the minimum interference with the rapidity of fire of each gun.

50. (1) Details of loading a R. F. gun (fixed ammunition).—The following detailed description of "Loading," though differing slightly in details from the drill submitted by the board on intermediate gun-drills, North Atlantic Fleet, and included in this book, is the method which has produced the greatest rapidity of hitting with the 5-inch R. F. gun.

Load! The pointer and trainer each sight with the same eye, and keep their cross-wires continually on the target. The sight-setter keeps his right hand on the elevating (range) wheel, and his left hand on the azimuth wheel, or vice versa, in order that he may perform continuous sight-setting.

(2) The plugman stands to the right and rear of the breech in such a position that when his right arm is extended he can reach the lever-handle when the plug is open, and with his left arm extended he can reach it when the plug is shut. His feet are spread apart and remain immovable until the gun is trained, in which case he shifts his position relative to the breech.

(3) On counter-recoil, or during counter-recoil, if possible, he opens the breech with his right hand, holding the breech entirely open with his right arm fully extended.

(4) On closing the breech, the reverse operation takes place with his right hand until the operating lever is 45 degrees from being closed, then he shifts his left hand to the operating lever, and completely closes the breech. During this last 45 degrees, his left hand is open (not grasping the handle), his left arm extended across the breech, thumb in line with lever-handle; and should the pointer fire before the plugman warns him (or order *Ready*), or should the act of closing the breech fire the gun, no harm can result.

(5) Each of the three shellmen carries a cartridge with its projectile in the hollow of the left arm, at the elbow, and approaches the breech from the left side, the cartridge always pointing exactly in the same direction as the bore, and while waiting to load stands facing to the right with the nose of the projectile exactly abreast the rear face of the gun. To load, the shellman steps one pace forward (that is, to the right, as you look toward the muzzle), holds his breath to avoid inhaling fumes from gun, rests his left lower arm against the lower part of the face of the breech, and at the same time enters the nose of the projectile carefully. When entered about 6 inches, he completes the remainder of the loading quickly, his right-hand fingers remaining against the face of the cartridge-case until it brings up against the extractor. He should not shove the cartridge home hard, as he may thereby displace the projectile. Then as the breech-block is closing, withdraws his hand quickly. As soon as he withdraws his hand, he faces about to the left, and stands not more than two feet from and exactly in rear of the breech, his arms extended in the direction of the breech,

ready to withdraw the empty case. Upon the breech being opened, he withdraws that empty case, moving backward, to the right of the gun (not in any case to the rear, for that interferes with the next shellman), out of the way, and deposits the empty case in a designated place. He then gets another cartridge and takes his position close up to the shellman waiting to load, and loads in his turn.

(6) Some shellmen are timid and will stand too far away from the breech to extract the cartridge efficiently, without moving closer to the breech on gun-fire; if the division-officer will instruct these men that they are as safe two feet away as they are two yards away, their fears will disappear. The shellman waiting in rear of the breech to extract the empty case should not hold his arms extended out stiffly in the direction of the breech, but have them flexed at the elbows.

(7) In case fuses are to be cut or set, the division-officer must designate the most advantageous place for the shellman to carry out this work. The sight-setter must be able also to give the correct fuse-cutting time, in case the division-officer cannot be present.

(8) Note.—With this drill, the plugman does not *have* to sing out *Ready*, or touch the pointer, when the gun is loaded, which warning is entirely inadequate when other guns than his own are firing. In this case, and in action, it shall be understood that the pointer fires when he is on the target. The plugman (who is usually the gun-captain) has in this way more complete control over the rapidity, number of shots, etc., than by any other method.

Miscellaneous Notes on Gunnery.

51. (1) The following miscellaneous notes relating to gunnery are based on experience derived at the U. S. Naval Proving Ground.

(2) If practicable, do not clean a gun between its trial shots and the target-practice, and do not depend upon the first shot out of a clean gun for a trial shot. It has been found, both at Indian Head and the U. S. Army Proving Grounds, that the first shot out of a clean gun is generally off the velocity curve—*usually low* in velocity but sometimes high, and *rarely normal*. There is no complete explanation of the *erratic* behavior of first shots, though the low temperature of the bore usually decreases the I.V.; and the oil, etc., in a clean gun probably influences the trajectory.

(3) A trial shot fired with one index of powder will, in many cases, be of no use for any other index, unless the indices have recently been ranged. Two powders, though kept under the same conditions, will not always dry out equally, and while one may give about the same results one or two years after proof, another may give much higher pressures and velocities.

(4) Watch the first shell shoved home in a clean gun. If the gun is elevated (as by ship rolling) the shell is very apt to slip back and not be home when the gun is fired. This is caused by oil on the compression slope, and it may occur after the powder-

charge is home, and thus not be seen. Its effect is to reduce the velocity. If the shell is persistent in slipping back, tie a little grommet of small twine around it just forward of the band. If a shell goes home properly it emits a non-mistakable, clear, ringing sound. If it gives a dull thud it is not home. The 12-inch 40-caliber guns have to be particularly watched on account of the steepness of the slope.

(5) For trial shots see that the shell is shoved home as far as it will go, as that will be the position of the shell for subsequent shots fired at target-practice. If the origin of the rifling is worn, the shell will go home further than was originally intended, thus changing the density of loading, but if all shells are shoved home as far as possible, the I. V. of all will be the same, and differences in range can be corrected by altering the sight-bar range.

(6) Make sure that all shell are of equal weight and try to have them of standard weight.

(7) **Temperature of powder.**—Too much stress cannot be laid on the temperature of the powder when fired. When going into target-practice the powder should always be at the same temperature as when the trial shots were fired; and to get the best results it should be the temperature at which the powder was proved, i. e., 90° F. (See table, page 289, showing changes in I. V. due to a change in the temperature of powder.)

(8) If for any reason a powder-charge is allowed to remain in a gun for 10 or 15 minutes, do not fire it. Replace it, if practicable, by another charge having the normal temperature of the charges being fired, otherwise the charge left in the gun will take up the temperature of the chamber, thus producing a higher or lower I. V.

(9) Do not fire a gun with the screw-box and breech-plug threads covered with grease or oil—the set-back of plug when fired will tend to unlock it and may carry away some of the locking-mechanism. There is no danger, but it brings an unnecessary strain on worm-pinions, etc.

(10) Unburned tape is frequently found in the bore of guns using powder-bags bound with woolen tape. This sometimes smoulders after the breech is open.

(11) In 12-inch, 40-caliber guns the powder-chamber is so large in comparison to the entrance that the bags often lie so low in the chamber that the ignition-scrim is considerably below the primer-vent. The result is that the flame from the primer strikes into the strengthening bands around the edge of the scrim and causes a miss-fire or hang-fire.

(12) The use of alcohol is recommended around all electrical connections in cleaning up for use, as it cuts away the grease.

(13) Turpentine is recommended around parts (non-electric) that are stiff from improper care or rust (when there is not time to overhaul). It should, however, never be used around an electrical firing-lock or connections.

(14) Never fire a primer with a tompon in the gun—it may blow the latter overboard.

(15) Tompons and bore muzzle-sights, fitted with a small vertical or other object, visible from the breech over the gun, will often prevent them being blown overboard, and prevent the muzzles of guns being swelled or blown off. The tompons of saluting guns should be so fitted at all times, while these marks should be fitted to the tompons of other guns when general preparations are being made for regular target-practices or other firing.

(16) Keep primers that have been fired out of reach, otherwise somebody may try to use them again. This has not infrequently happened.

(17) When using a percussion- or combination-primer, never slam home a breech-plug that is fitted with a protruding firing-pin. A strong firing-spring or an over-sensitive primer will be apt to cause a premature explosion. Equal rapidity of fire can be attained by closing the plug properly.

(18) It is recommended that when trial shots are fired, the length of recoil should be observed, thus verifying the efficiency of the recoil cylinders.

(19) **Clearing the vent.**—It is seldom necessary to clear the vent. If it be found necessary, the priming-wire should be used from the forward end of the plug, care being taken to avoid scoring the primer-seat. After clearing the vent with the priming-wire, take care to clean thoroughly the primer-seat with the vent-cleaner. In case of a blow-back, the vent and primer-seat should be examined for scoring and thoroughly cleaned. The vent-drill will not be used except under the direct supervision of an officer.

NOTES ON COMMENCE FIRING.

52. Sights.—Telescopic sights, when supplied, are to be used invariably when it is possible to do so. The telescope, when set at low power, can be efficiently used at night if a search-light is used or if a light is thrown on the object-glass or thrown up into telescope-barrel, thus illuminating the cross-wires. The open-

and peep-sights now being supplied alongside the telescope are purely for auxiliary use.

53. (1) Electric and percussion firing.—Firing by electricity is by far the most accurate and satisfactory, and is to be the general practice with all guns so fitted; percussion firing is to be used only as an alternative.

(2) Electric firing requires, however, great care, and in order to get the best results, contacts must be tight and all the surfaces must be free from oil or other insulating substances. Whenever it is possible, all terminals should be made so strong that they can be set up and kept tight at all times.

54. (1) Training and pointing.—With all guns and torpedo-tubes the commands **RIGHT!** or **LEFT!** refer to the muzzle of the gun or tube, that is, the gun or tube is pointed in the direction indicated by the command. Since pointing in elevation is always done by the pointer, commands for elevating or depressing will seldom be used. In case such commands become necessary, **RAISE!** or **LOWER!** will refer also to the muzzle of the gun.

(2) **As trainers** will generally have their own sights to guide them, the command **RIGHT!** (or **LEFT!**) means to get on the target by training to the right, *and keep on it*. The pointer should command *on* when his cross-wires are on, and the trainer should keep his gun pointed as it was at the *on* from the pointer, training right or left as necessary, without further commands from the pointer. Though the trainer may find his own sights *on*, he should promptly respond to the pointer's commands of *right a little* (or *left a little*), and should note the exact position of his wires at the *on* of the first-pointer (or at the instant of firing), and after firing he should quickly replace his cross-wires at this exact position.

(3) **In intermediate-battery guns**, where the pointer and trainer are required to change stations and continue a rapid fire, it has been found best to require each of them to sight with the same eye, and to use the same eye always whether pointing or training.

55. The cartridge-case of a R. F. gun always contains an inflammable gas immediately after it is ejected from the gun. Special Order No. 57 requires that before these are stowed below they shall all be freed of this gas.

56. (1) Deflection.—The following general instructions give the adjustment of the deflection-scale under ordinary circumstances.

(2) With deflection-scales graduated in knots only, the word "knots" may be omitted in transmitting orders, thus, "12 RIGHT" means "*12 knots right.*" In transmitting orders for changes in deflection in knots, *each order must refer to the zero of the scale.* Thus, if the scale is set at "*25 knots right,*" and it is desired to change it to "*30 knots right,*" the command must be "*30 RIGHT,*" and not "*5 (knots more) right.*" Similarly if a yard scale is set at "*40 right,*" and it is desired to move the pointer 10 yards left on the scale, the command must not be "*10 left,*" but "*30 right,*" that is, reset the scale at "*30 right.*" In this manner an error in transmitting an order will apply only to one reading of the scale, that is, the error will not be carried on, but will be rectified by the next order that is correctly transmitted.

(3) Always move the rear sight, or eye-piece of the telescope, either in elevation or laterally, in the direction in which it is wished to bring the next shot to correct the error of the last one.

(4) The amount of deflection due to the speed of the firing ship (when target is stationary) varies as the sine of the angle of bearing, that is, full deflection is allowed when the target bears abeam, and this is decreased as the sine of the angle of bearing. Similarly, deflection due to the speed of the enemy depends upon the angle between the line of fire and the course of the enemy, being full deflection when the enemy's course is at right angles to the line of sight. It is exactly half of the full amount when the enemy is crossing the line of fire at an angle of 30° .

(5) **Effect of wind.**—By judgment alone can we estimate approximately the amount of deflection to be allowed for wind. At short ranges the effect of wind on heavy shell is negligible, but its effect increases rapidly as the caliber diminishes. Similarly, the effect of wind which is not apparent at short ranges becomes very marked at ranges from 4000 to 6000 yards.

(6) **In estimating the deflection** for the first shot, estimate first the deflection due to the speed of the ship and bearing of enemy. To this apply in proper direction the deflection due to the course and speed of the enemy, and finally apply the estimated deflection due to wind. This is of course for first shots only. After that, move the deflection scale to the right or left, to correct for observed fall of shots. If powder requires a considerably increased range to hit, the increased time of flight will require a corresponding increase on the deflection-scale.

(7) Except when the ship is at target-practice on a measured range, no time should be lost in attempting to make

the above estimates with accuracy, since those for wind and for speed and course of the target must necessarily be approximate only. The fire-control officer should, nevertheless, thoroughly familiarize himself with the principles involved, and with the amount of deflection necessary to correct for projectiles of various calibers when fired at various battle-ranges on various lines of bearing and across wind of various apparent forces. When this is done intelligently, the first shot should fall near enough to the target to enable succeeding shots to be brought on, and kept on, by applying an estimated correction on the deflection-scale. The sole object of the preliminary estimate is, therefore, to bring the first shot within manageable distance of the target.

57. (1) Designating object and range.—The foundation of successful fire-control requires that all sights be set to give the same range, and that the gun-pointers aim exactly as directed, hence the necessity for an efficient system of communicating range and deflection from the fire-control officer to the various guns. The fire-control officer estimates in knots the amount of deflection for the first shot, and thereafter alters his first estimate to bring the shots on the target.

(2) It is the duty of the division-officer to see that the sight-setters get the signals as soon as possible, as long as communications are intact. When communications are interrupted, the division-officer must himself control the fire of his guns.

(3) The object, the bearing of the object and the point of aim must always be clearly designated, in the order named, and immediately followed by the distance and the deflection. For example, *At ship on bow, at forward turret, 4000, 10 right.* According to the fall of the first shot, the range and deflection may at once be changed. For example, *4200, 15 right.*

(4) Instructors must impress upon the pointers the fact that object and range go together, and hence the gravity of the mistake of firing with the sights aligned on the wrong object.

(5) In view also of the fact that only certain projectiles can be effective against certain portions of the enemy, the pointers must be impressed with the necessity of aiming at the particular part of the ship designated, being particularly careful to place the vertical wire as nearly as possible where directed.

(6) The vertical height of the target is such an important element in determining the number of hits possible, that, generally speaking, the pointer should be directed to aim half-way between the water-line and the top of the object it is desired to hit. For

example, *At forward turret*, aim half-way between the water-line and the top of the turret. If aim were taken at the middle of the turret itself there would be great danger of losing many shots by having them pass over. Thus the designation of the part of the ship applies to training only, the elevating-pointer always laying his horizontal wire half-way up from the water-line. In particular cases, at short ranges, this rule may be modified by special order to aim directly at the middle of a particular turret or gun-position.

58. (1) Slow-fire and rapid-fire.—Though gun-crews are *trained* to fire with the greatest possible rapidity in case of necessity at short ranges, it may frequently be desirable to fire slowly, especially at long distances, to test the accuracy of the sight-bar range, to steady the nerves of the men, etc.

(2) In such cases, the command SLOW FIRE! will be given. At this command, unless the desired rapidity of fire is otherwise indicated, guns less than 8 inches in caliber will fire not oftener than one round per minute, 8-inch guns and above not oftener than one round in two minutes. In slow fire, guns will fire each round under the order of the division-officer who commands (designating object and range): *Fire the —— gun (or guns).* The pointer will fire when his sights are in alignment. The gun-crew will then load and stand by to fire again at command.

(3) If a greater or a less rapidity than the above is necessary, the time desired between shots will be communicated to the division-officer.

(4) When slow fire is no longer required, the command RAPID FIRE! will be given. The crews will then fire their guns at the greatest practicable rapidity, but it should be impressed upon the pointer that unless the object and range are clearly understood, it is a waste of ammunition to fire, and that in no case will he ever fire except when his cross-wires are on the object indicated.

59. (1) Protracted rapid-fire.—In case of necessity, gun-crews and ammunition-crews of the unengaged battery should assist in keeping up the supply of ammunition, in protracted rapid-fire.

(2) **Filling up ready-magazines and shot-racks.**—During an engagement, advantage will be taken of every opportunity such as a temporary cessation of the fire, or opening fire from the other battery, etc., to fill the ready-magazines, and the shot-racks where fitted.

NOTES ON CEASE FIRING.

60. The following indicates what is done at the command CEASE FIRING!

(1) Breech-loading guns.

(a) *Using electric primer.*—Leave cartridge and projectile in the gun, breech closed, break contact at attachment-lug. Remove primer from primer-seat.

(b) *Using percussion primer.*—Remove primers from primer-seat. Leave breech closed.

(2) Rapid-fire guns, with powder charge in brass case, using either electric or percussion primers.

(a) If charge and projectile are separate. Remove cartridge-case, close breech.

(b) If using fixed ammunition, remove cartridge, close breech.

(3) Machine-guns.

(a) Place small lever in "safety" position and clamp gun.

(b) If CEASE FIRING! is given while loading, the loading is to be completed and the gun placed in *Cease Firing* position.

61. Throughout the drills, when mention is made under *Loading*, *Unloading*, or *Cease Firing*, that the gun will be primed (or primer withdrawn) when breech is "nearly closed," or that the plugman will "turn plug-crank back just enough to break electric connections," it will be construed to mean that the electric connection at the attachment-lug will be broken about $\frac{1}{4}$ of an inch.

62. Before a gun-crew leaves its gun at any time the gun is to be placed in the *Cease Firing* position.

NOTES ON UNLOADING.

63. (1) It will be noted that at the command UNLOAD! B. L. guns require both the charge and projectile to be withdrawn. With R. F. guns, using separate ammunition, withdraw projectile, also the charge if it has not been withdrawn at command CEASE FIRING! R. F. guns using fixed ammunition are unloaded at the command CEASE FIRING! hence the command UNLOAD! with such guns is unnecessary—after the command CEASE FIRING! If the command COMMENCE FIRING! has not been given, the command UNLOAD! would be used to unload the gun.

(2) Owing to the fact that greasy powder-bags contain all the elements necessary for spontaneous combustion, it is directed that when it becomes necessary in actual firing to withdraw a charge

from a gun, the bag be carefully examined for grease. If other shots of this caliber are to be fired on that practice this charge will be used. If the bag is found to be greasy, and firing with that caliber is completed, the charge will be placed in spare powder-bags, which are furnished, and the greasy bag will be washed and retained for further use.

(3) Though the primer is extracted at the command CEASE FIRING! the notes on *Unload* prescribe the withdrawal of the primer, as this command *may* be given after loading and prior to the command COMMENCE FIRING!

NOTES ON SECURE.

64. As soon as possible after firing is discontinued, the gun should be thoroughly washed out; the first washing is with salt water and deck-hose with a heavy pressure, after which fresh water, and the bore bristle-sponge will be used. The bore will then be thoroughly dried with a carpet or sheepskin-sponge, then thoroughly oiled—the entire gun-crew will assist at this operation. If practicable, the bore should be cleaned while it is still hot, and it must never be oiled until it is perfectly dry.

NOTES ON SIGHTS, FIRING-ATTACHMENTS, MISS-FIRES, PRIMERS, GAS-CHECKS, ETC.

GUN-SIGHTS.

65. (1) **Open-sights** are those in which two points on the gun determine the line of sight. These are being rapidly superseded by telescope- and peep-sights.

(2) **Peep-sights** generally consist of a diaphragm, with a small hole in it, fitted with a rubber buffer for steadying the head, and a cross-wire front-sight. It is thus practically a telescope of one-power. It is used as an auxiliary to telescope-sights, and to replace the ordinary open-sights on secondary guns.

(3) **Telescope-sights** are those in which the line of sight is determined by the line of collimation of a telescope (marked by vertical and horizontal cross-wires), the telescope being so attached to the gun that the line of sight can be set at any desired angle with the axis of the gun.

66. The sights of a gun require most careful attention. They should be kept in proper condition by the division-officer, and he should allow no one except himself to dismount or assemble the sighting-mechanism (or the telescope, if so fitted). The sights should be handled as little as possible, as each time they are worked, lost motion in the various worm-gearings, etc., is increased.

67. Open training-sights, as now provided for some intermediate-battery guns, are not capable of a high degree of accuracy on account of the V-notch used in the rear-sight. This rear-sight can be improved by replacing the V-notch by a vertical wire, or narrow slit in a metal plate. This change can be made on board ship by the ship's force, in case of necessity. In the case of open-sights, it has also been found that a patch, sufficient in size to shut out all light, worn by the pointer or trainer over the unengaged eye will materially relieve the strain of sighting.

68. Special instructions in regard to open- and peep-sights, their care and adjustments, are unnecessary, as the general principles governing the care and adjustment of telescope-sights apply also to open-sights.

Telescope-Sights.

69. (1) There are three varieties of telescopes in use as gun-sights in the Navy.

(2) The first type with universal focus, that is, with no adjustments for focussing, power $2\frac{1}{2}$, field of view about 17° .

(3) The standard variable-power telescope. By adjusting the eye-piece, it varies from 3-power with field about 10° to 10-power with field about 4° .

(4) Variable, high-power telescope. The same as 3, except that, being longer, the power is doubled (6 to 18-power) and field decreased. This is still an experimental telescope, only about a dozen having been ordered. The description of the standard, variable-power telescope applies equally to these, except that the power is doubled.

NOTE.—On the Asiatic station in 1903 a number of telescopes, in power from 9 to 26, were bought and fitted on some of the ships. These special sights and their appliances are so various that their description is not attempted.

Notes on the Care, Adjustments, etc., of Telescopes.

70. These notes apply more particularly to the old-type telescope. The standard, variable-power telescope is described in this chapter from notes furnished by Mr. Geo. N. Saegmuller.

71. (1) **The telescope caps and cover** should be kept on at all times that the sight is not in use.

(2) **Telescopes which are not to be used within 24 hours** should be removed from the gun, placed in their boxes, and stowed in a warm, dry place.

(3) **Telescopes are not to be cleaned** with anything except a dry cloth, which should, however, not be allowed to touch the lenses, for the care of which special instructions are given below.

72. (1) When they are required for use they are to be carefully shipped in their proper places. The old-type telescope-mount and "sword" are secured together and are unshipped together. On reshipping, be careful that the lock-bolt is set up firmly.

(2) **The variable-power telescopes** are removed from the telescope-sleeve and stowed in their boxes, leaving the mount on the gun. On reshipping them be careful to get the part marked "top" uppermost. The line of collimation of our telescopes does not in all cases exactly coincide with the geometrical axis, hence the necessity of the above precaution.

(3) Care should also be taken that the tubes of the telescope are not dented or otherwise distorted, for in that case the axis of the telescope might be considerably deranged.

73. Whatever precautions are taken, if opportunity offers, the

gun should invariably be bore-sighted after reshipping a telescope-sight.

74. (1) **The cross-wires** are stretched on a diaphragm in the eye-piece. This diaphragm is capable of slight movement so that the wires can be placed accurately in the focus of the telescope, that is, in the position where the image is formed.

(2) **If the diaphragm is out of position**, the resulting parallax will cause serious errors in pointing; therefore before attempting any other adjustments, the parallax of the telescope must be eliminated. To test for parallax, lay the telescope with the horizontal wire on a distant object, and move the eye up and down at the eye-lens. If the horizontal wire apparently moves down on the distant object as the eye is raised, the cross-wires are too close to the eye-lens, but if it apparently moves up as the eye is raised, it is too far from the eye-lens. (An apparent curving of the outer ends of the wire should not be mistaken for parallax.) Move the diaphragm gradually, avoiding cockbilling the wires, until it has reached such a position that, when the eye is moved up and down the horizontal wire appears to be fixed on the distant object; then carefully secure the diaphragm in place. In some of the old telescopes it has been found necessary to elongate the adjustment slot in the telescope-tube in order to place the diaphragm in a position to remove all parallax.

(3) When taking the telescope apart for cleaning lenses, be careful not to touch the cross-wires with the fingers, as they are easily bent or broken. The dust on cross-wires may be removed with a small camel's-hair brush, but even then care must be observed.

(4) **To renew broken cross-wires**, remove the diaphragm from the eye-piece tube, and scrape off the old solder from the face of the diaphragm, thus disclosing the grooves for the wires. Then remove the solder from the grooves with the point of a knife, being careful not to widen the grooves. Place the diaphragm in a vise, being careful not to squeeze it hard enough to distort it, otherwise after a wire is soldered in and the vise comes up, the wire will be found slack. Lay a piece of the regulation wire (platinum .001-inch diameter) across the diaphragm in the grooves, the proper tension being given by the weight of a small piece of lead on each end. These are most conveniently attached to the ends of the wire by partly splitting the lead and then nipping it firmly on the wire by means of a pair of pincers. After a wire has been successfully laid on the diaphragm, touch each groove with a

small stick that has been dipped in muriatic acid, then over each part of wire in the groove lay a small bit of solder. After heating and "tinning" a small soldering-iron, touch each piece of solder. After soldering the first wire shift the diaphragm in the vise and put in the second. After both wires have been soldered on, carefully shave off the excess of solder from the diaphragm with a sharp knife.

(5) If regulation wire is not available, human hair may be used as a substitute, attaching it to the diaphragm with a drop of collodion, one end at a time, and pulling gently, after one end is attached, to give it a tension. The hair will be found almost twice as thick as required, and in time will be found slack and require renewing.

(6) When assembling the telescope be particularly careful to see that screw-threads are correctly engaged, and set up tight enough to prevent danger of jarring loose when firing. Avoid using too much force on the diaphragm set-screws, or the threads will be stripped.

75. (1) The lenses must be firmly secured against turning, especially the object-lens. In the latest telescopes the object-lenses are so fitted that they cannot turn. If the lenses do turn, it throws the line of sight off in the same way that turning the telescope in its carrier may do.

(2) Wiping off lenses.—It has been found, especially in firing guns to windward, that the residue or fumes from smokeless powder clouds the object-lens (the one farthest from the eye) and perspiration clouds the eye-piece, thus *occasionally* requiring that they be wiped off. For this purpose the pointers and sight-setter should each be supplied with clean, dry, soft *linen* rags (neither cotton nor woolen will answer) or, if not available, "Selvyt" will do quite as well.

(3) Clean chamois skin is also suitable, but is expensive. Many officers recommend the use of soft, dry tissue paper for this purpose, and while *soft white* tissue paper is not bad, so great is the difference in qualities of tissue paper, and so likely are the men to fall into the habit of using ordinary toilet-paper, which is gritty, and scratches and destroys the polish, that the use of tissue paper is not recommended, except in an emergency, and then only very soft paper will be employed.

(4) It is important that the pointers and sight-setter should be supplied with suitable material for wiping off lenses, otherwise they will use cotton, cloth, waste, handkerchiefs, or some other unsuitable material, despite the precautions of the division-officer.

76. (1) Before bore-sighting the gun it is very important that the lenses be immovably secured, and the sight-setter should see to this point every time he wipes off a lens. The turning of a lens either in its mounting, or the partial unscrewing of the mounting itself may cause very large errors by altering the direction of the line of sight.

(2) The lens that requires the most particular attention is the field-lens (the second from the eye), because dust or impediment on this is distinctly seen, being magnified by the eye-lens. The next in importance is the object-lens.

(3) If the lenses are very dirty and greasy, they should first be wiped off gently with a weak mixture of alcohol and water, and then thoroughly dried by gentle rubbing with chamois skin or one of the materials indicated above. Always handle the lenses by their edges. The sight-setter will wipe off the pointer's sight, but the trainer must wipe off his own. The lenses should never be wiped off *except when necessary*, as any wiping must inevitably reduce the polish, and the men should be specially cautioned against this.

77. Focussing.—The old-type telescope is not adjustable, being of universal focus. The variable-power telescopes are focussed by sliding the inner tube in or out (after adjusting outer tube for desired power), until there is no parallax. This position of no parallax marks the position of accurate focus. Once focussed at, say, 2000 yards, the telescope requires no further adjustment for any distance for which it is to be used by the same observer.

78. Bore-sighting.—When practicable, the last thing to do, before firing, is to bore-sight the gun. Variable-power telescopes can be changed from high to low power without materially altering the line of sight; but clamping the telescope-tubes, or the telescope itself in its carrier, are liable to slightly derange the line of sight.

Description of the Standard Variable-Power Telescope.

By MR. GEO. N. SAEGMULLER.

79. (1) The following description of the standard, variable-power telescope was prepared by Mr. Geo. N. Saegmuller, the inventor of this telescope. It is printed *in extenso* although it repeats certain details already touched upon above.

(2) The underlying principle in increasing or decreasing the power of a telescope consists in the fact that the power of any telescope is the quotient of the focal length of the object-glass divided by that of an equivalent lens of the eye-piece. The word "equivalent" in connection with eye-piece means the comparison of the magnifying power of the compound eye-piece with that of a single lens of a certain focus. Thus a compound lens which

is mentioned as the equivalent of *one inch*, magnifies as much as a single lens of one-inch focus.

(3) In the old wide-angle telescopes of the Navy an object-glass of about four inches focus was used, and the eye-piece was the equivalent of a lens of $1\frac{3}{4}$ inch focus. Thus the resulting power of the combination was just about $2\frac{1}{2}$ diameters. If the power of the eye-piece is changed to an equivalent of, say $\frac{1}{2}$ inch, it is clear that the resulting power will be eight. As a matter of fact the eye-piece in the new telescope is so constructed that the equivalent can be changed from $1\frac{3}{4}$ inch to $\frac{1}{16}$ of an inch, which, with the objective of 4 inches focus, gives a range power from $2\frac{1}{2}$ to exactly 10. The variation actually obtained is 3 to 10 power.

(4) The changing of the power of the eye-piece is accomplished by separating the two systems of lenses composing the eye-piece. By bringing the lenses close together we have a low-power eye-piece, as will be seen by looking at the drawing where the pencil of rays, as it leaves the first combination, enters the second system before they have diverged too much; the image is consequently small and the "working" focus of the eye-piece is considerably in front of the first combination.

(5) By separating the two systems the image becomes large and the resulting working focus (which is nearly the equivalent focus of the eye-piece) becomes very much shorter.

(6) With eye-pieces of the ordinary construction these results cannot be accomplished; the lenses have to be specially ground, and some of them have to be made achromatic to avoid distortion and color around objects. The case is further complicated by the requirement that the place for the eye be at a considerable distance away from the eye-end, in order to give space for an elastic cushion between the eye and the eye-piece, to protect the eye from blows due to the recoil; and as this distance changes from high to low power, the single achromatic eye-lens had to be discarded for a double achromatic one, which satisfactorily solves the problem and is now used in all new telescopes.

(7) Now the "apparent" field of any eye-piece is the angle subtended in the eye-point by the diameter of the diaphragm, and the "effective" field is found by dividing the apparent field by the magnifying power of the telescope. Thus it will be seen at once that with an increased eye-distance it was necessary to increase the diameter of the diaphragm so as not to reduce the field, which again changes the dimensions of the lenses.

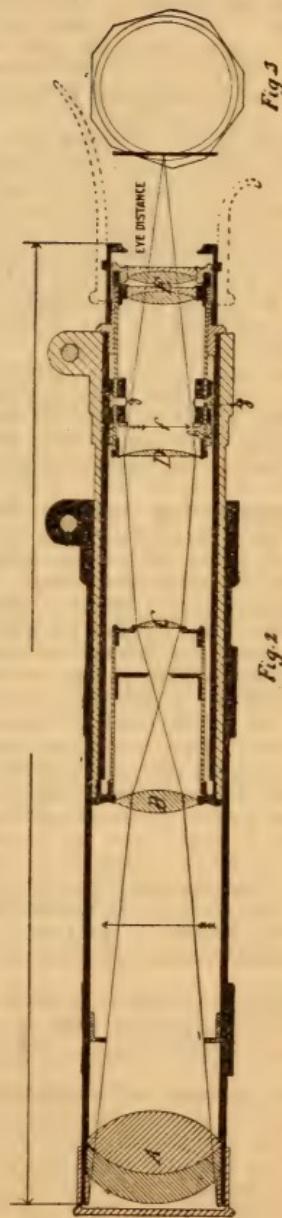
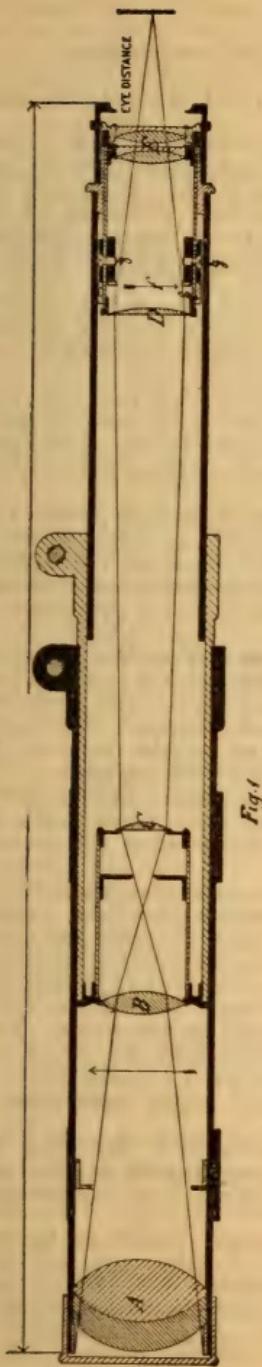
(8) As it is very important that the line of collimation shall not change when changing from high to low power, and vice versa, it has been found necessary to use tubes of heavy wall-thickness, which have to be ground exactly true inside and out, so that clamping will not affect the alignment.

(9) In order to make all telescopes interchangeable, so as to point to the same spot when secured in the same support, it was found necessary to make the body of the telescope of a pentagonal cross-section, instead of a cylinder. The telescope rests on two sides which can, by filing or scraping, be adjusted so that one telescope will point at the same spot as any other. The clamping is done from above on the horizontal side without danger of moving the telescope sideways.

(10) To make the optical axis of the lenses pass exactly through the geometrical axis of the telescope would require absolutely *perfect* workmanship in centering and setting the various lenses, operations which would increase the cost of construction enormously. And even if all the lenses were mounted perfectly symmetrically, the result would not be certain, as some lenses refract differently from others, owing to varying density of the glass, a fact which cannot be discovered until the lens is completely finished and mounted.

80. (1) Description of the telescope.—The sketch shows a section of the variable-power telescope through its length,—Fig. 1, when set for high power, Fig. 2, for low power.

(2) Fig. 3 shows a cross-section through the telescope-barrel, the sides *b*, *b*, being the bearing surfaces in the support; *c* is the top surface upon which the clamp acts.



(3) Referring to the letters on the sketch, the following are the names of the lenses:

A Object-glass.

B Field-lens.

C Erecting-lens—*B* & *C* form the erecting combination.

D Collective-lens.

E Eye-lens system (double achromatic)—*D* & *E* form the eye-piece combination.

F Is the focal-plane. Here the image is formed and the cross-wires are placed. The diaphragm carrying the cross-wires being on the forward surface nearest the object-glass. The diaphragm is movable in the direction of the telescope's axis, and by means of two screws, *g*, *g*, can be clamped firmly when it is in the correct position.

(4) It is in the correct position when the cross-wires remain immovable on the object when viewing the same while shifting the eye across the eye-lens. If they remain stationary they are said to be without "parallax." Repeated trials are necessary to get the cross-wires into the correct position, and care should be taken to use the rubber shield in front of the eye-lens so as to place the eye at the correct distance.

(5) There is another clamping-ring in front of the two clamp-screws which hold the cross-wires. It is marked *h* in the sketch, and its purpose is to allow the rotation of the cross-wires (so as to get the horizontal wire parallel to the horizon) without shifting them out of focus, which would cause parallax.

(6) If the wires are accurately adjusted for a certain power, there will be no parallax when the telescope is in focus at any other power, since the correct position of the wires is exactly in the focus of the eye-lens system. Being a double achromatic lens this position is very accurately defined.

(7) All that is necessary is accurately to focus the telescope at the new power.

81. Directions for setting the telescope.—For low power (about 3 diameters) and large field (about 12°), pull out the middle draw-tube as far as it will come and clamp slightly. Then push outer draw in until the telescope is properly focussed. Secure both clamps. For higher powers (and correspondingly smaller fields), set the middle tube to the desired power, as indicated by the numbered line, and clamp slightly. Pull out the outer tube until the telescope is properly focussed. Secure both clamps.

82. (1) Cross-wires.—The cross-wires are 0.001 of an inch in diameter and are made of platinum. Should they break they can be replaced on board ship in the following manner:

(2) Unscrew the eye-piece, remove the two clamp-screws, *g*, *g*, and the collective-lens *B*, when the diaphragm carrying the cross-wires can be taken out. Place it on a table with the screws (holding the wires) on top; loosen these four screws slightly and remove the ends of the broken cross-wires; take a new piece of platinum wire and draw it taut between the two fingers. Fasten one end of wire around one screw and clamp it, taking care that the wire lies in the score ruled on the plate. Then take the other end and stretch it across the diaphragm into the score ruled on the opposite side; stretch it so that it is straight but not quite taut. Then turn the screw gently, until it clamps the wire and at the same time stretches it taut.

(3) Triangular-headed screws are provided for securing the clamps. They are so fitted that they can only be unscrewed by the specially-constructed, key socket-wrench, which should remain in possession of the officer of division.

(4) **New system of cross-wires.**—A recent variation in the arrangement of the cross-wires consists in using a double, compound-lens, on one of which the cross-lines are engraved, instead of a single lens with the cross-wires placed behind it, as was the case heretofore. The lenses are cemented together, and, as both of them are of considerable thickness, particles of dust that may fall on either exterior surface will be out of focus, the eye-piece system being focussed on the cross-wires. The periphery of this compound-lens is polished and silvered, a small opening in the silvering being left for the admission of light from the side. The light

entering through this opening is reflected in all directions from the circular, silvered surface; and the cross-lines, being evenly illuminated from all sides, stand out as bright lines on a dark background.

(5) This is of great importance when an object shows dimly, in the twilight, when ordinary cross-wires would be scarcely visible. A bright illumination of the field—with consequent dark lines—will obliterate the dim outline of the object.

(6) The illumination of the lines can readily be accomplished by means of a small incandescent lamp, and if a rheostat is provided the lines may be made to appear dull red, or quite bright.

(7) This arrangement overcomes the vexatious difficulty of replacing broken cross-wires.

83. (1) Precautions.—All clamp-screws for securing the telescope in its sleeve and for securing the eye-tubes after changing the power and focussing, should be set up hard before bore-sighting, and if it is necessary to slack up on any of these clamp-screws, the bore-sighting should be verified, as it will sometimes be found to be out somewhat.

(2) Care must be observed that all screws about the telescope are set up taut before firing, as the shock of discharge has a tendency to slack them up.

(3) Particular attention must be given to see that the object-glass is securely screwed in position and that it will not turn. The turning of the object-glass introduces large errors in the line of collimation. In all new model telescopes the object-glass is secured in such a manner that it cannot turn, nor be inserted hindside foremost.

(4) The combination of inner lenses is permanently secured in the inner tube and there should not be any occasion for touching it on board ship.

84. Cleaning the glasses.—Do not rub or touch any glasses unless absolutely necessary; a little dirt on the object-glass does no harm. The eye-end lenses should, however, be kept clean, and care should be taken to use preferably a very soft linen rag free from dust, so that in wiping, the polish of the lens is not affected and the lens is not scratched. A little alcohol on a rag will help to remove stains or grease. If a clean, soft linen rag is not available, "Selvyt," or a piece of chamois skin, should be supplied, or if these are not available, a piece of soft tissue paper may be used. There is a great difference in tissue paper, much of it is gritty and such paper injures the lens by destroying the polish and scratching the lens. Soft white tissue paper is usually suitable, but ordinary toilet-paper is usually so gritty as to be injurious. In fact it must be remembered that lenses should be touched as seldom as possible, for each time they are rubbed off a certain amount of injury is done.

85. Ray-filter.—The ray-filters accompanying the telescopes are to be inserted inside the rubber shield close up to the eye-lens. In hazy weather they are useful, and clearly bring out objects which, without them, are cloudy and indistinct.

Sight-Mount Mechanism.

86. All working parts of the sight mechanism must be kept scrupulously free from grit and rust, and kept covered with a coating of good mineral lubricating oil. In turret-sights all bearing-pins should, when at sea and exposed to salt spray, be removed once a week, and in port once a month; the pins and bearing-surfaces then cleared of the old grease by washing in alcohol, thoroughly dried and covered with a fresh coating of oil. Emery-paper or gritty substances must in no case be used for cleaning. In those sights that are connected to the trunnions, or to the slide by a parallel motion, a slight looseness of the bearing will

cause a large vertical error in pointing. All bearings should be oiled and the gun moved daily through its arc of elevation and depression.

(1) In parallel-motion sights, though the greatest care be taken to avoid lost motion it is liable to appear in time, due to constant use at Morris-tube or dotter practice. To test for this, put in the bore-sight and lay its horizontal wire on a distant object; bring the horizontal wire of the telescope accurately on the same object by using the sight-bar. Then move the gun to extreme elevation and back until telescope wire is again on the distant mark; then to extreme depression and back until telescope wire is again on. If in either case the horizontal wires of the bore-sight and telescope do not coincide, there is lost motion in the parallel-motion mechanism. This may be caused either by looseness in the bearings, or by their fit being tight enough to cause a bending of the parts. The cause will readily be ascertained when the bearings are dismounted. The refitting of these bearings should be done only by an excellent mechanic, for the pins must have a neat working fit. If they are too loose, the possible vertical error is about equal to the product of the amount of looseness and the ratio of the range to the bracket-radius, but if they are too tight the vertical error may be still greater than this.

(2) The adjustment of the parallelogram must be very exact or there will be a vertical error in pointing if the gun is fired in a position of elevation different from that at which the sight-bar scale was adjusted. A very small error of adjustment would make a serious vertical error if the gun, being already elevated for the range, should be fired near the end of a roll toward the target.

(3) To test this adjustment, first adjust the knife-edges (or frictionless trunnions) to insure the correct length of that leg of the parallelogram which is the distance between the axis of the trunnions and the axis of the telescope-bracket. Then, having previously corrected the lost motion, attach one accurately-marked gunner's quadrant to the gun and another to the telescope, move the gun through its arc of elevation and depression, and, if there is no error, the angular change shown on each quadrant will be the same. Two legs of the parallelogram—the bracket-radius and the opposite leg—may be relied upon as being equal, therefore the adjustment can be corrected by changing the length of the leg which has the turn-buckle in it. When this has been changed (by motion of the turn-buckle) to the correct length, set up very

tight on the jam-nuts to prevent jarring out when firing, and do not disturb this adjustment until a test shows that it is required.

(4) Except when immediately and clearly necessary for actual firing, no change in the length of the connecting-rod should be permitted elsewhere than at a navy yard. In the first instance, when the mechanism is correctly installed, the length of the connecting-rod is made exactly equal to the distance between the axis of the telescope-table and the axis of the trunnions of the gun. This should be carefully examined into and checked immediately after commission, when the ship is at a navy yard and facilities for accurately sighting the guns are at hand. The adjustment should remain unchanged, but marks will be made on connecting-rods indicating the proper adjustment; but as unforeseen causes might derange the adjustment, it should be checked from time to time, during a cruise, when the ship is at a navy yard.

88. (1) In sights that have a drum instead of a direct-reading sight-bar, and a micrometer attachment instead of a direct-reading deflection-scale, there is likely to be found lost motion in the gearing that will cause serious errors in sight-setting. To test the drum for lost motion, lay the sight on a distant mark and, by means of the drum, elevate the horizontal wire well above and depress it back to the distant mark, then depress the horizontal wire below and elevate it back to the distant mark. The ship being stationary, the reading of the drum should be the same each time the horizontal wire is accurately laid on the mark; if not, there is lost motion in the drum-gearing.

(2) The deflection-scale is tested in a similar manner, using the vertical wire instead of horizontal wire.

89. (1) Lost motion in some forms of drums and deflection-scales may be corrected by fitting a small spring to take it up. In some forms of drums the shaft goes through a split nut; in this case the lost motion in the worm of the drum is taken up by first slackening the set-screws, then lightly tapping the nut until a neat working fit is secured and setting up on the set-screws.

(2) When it is found impracticable to get rid of the lost motion in sight-drums or deflection-scales, the final movement given to the drum or scale, before stopping at the reading ordered, must always be in the same direction, this direction being the same as that used in bore-sighting.

90. (1) When using the old form of bore-sight that consists of cross-wires for the muzzle and a small telescope for the breech, place a disc of paper, with a pin-hole in the center, on the rear face of the eye-lens, and sight through the pin-hole, thus practic-

ally eliminating the parallax of the bore-sight. This will be unnecessary with the improved bore-sights now being constructed.

(2) **Bore-sights must be handled with care.**—In case the cross-wires of the bore-sight have been broken or distorted, they may be conveniently renewed with cord of equal diameter, then tested for accuracy of the intersection by laying the gun on a distant object and rotating the cross-wire frame through 180 degrees.

91. (1) **The adjustment of all sights** should be personally supervised by the division-officer. The most favorable time is on a clear day when the ship is motionless, either in dry dock or in still water. The pointers should be present and should be given an opportunity of verifying the adjustment before firing; and in bore-sighting after firing, in case the pointers have made a poor score, they should be present to verify the adjustment of the sights. When ready to bore-sight, first see that the telescope is properly seated in its trunnions or, in the later types, is securely bolted in its socket. See that parallax is eliminated from the telescope, and that telescope-lenses, especially the field- and object-lenses, are clean, immovable, and all parts of the telescope secure. Adjust knife-edges (or frictionless trunnions), see that all lost motion is eliminated from the sight-mechanism, that the parallel-motion device is correct, and all nuts, bolts, and screws securely set up, except those that are to be used in adjusting scales, which should be slackened up. Select well-defined distant marks. If for target-practice, select a mark at a distance about equal to the mean target-practice range that is to be used; if for action, select a mark distant about 3000 yards.

(2) Lay the gun by bore-sights very accurately on the selected mark, then by motion of the deflection-scale lay the telescope so that its vertical wire is accurately on the same mark. The line of sight is now in the correct position for zero-reading of the deflection-scale, then make the reading zero by shifting the position of the deflection-scale or by shifting its reference mark, and firmly secure the scale or reference mark. Next, by motion of the sight-bar or drum, lay the telescope so that its horizontal wire is accurately on the same mark as the horizontal wire of the bore-sight, and secure firmly. The line of sight is now in correct position for zero-reading of sight-bar or drum.

(3) When both adjustments have been made and all parts secured, repeat all observations to make sure that the adjustments were not disturbed while setting up the securing arrangements. This, as well as the other adjustments, should always be made by an officer who has good vision; they cannot be too carefully

done, for on them depends, primarily, the number of hits that will be made with the gun.

(4) Before being satisfied with the reliability of all sight-adjustments, be particularly careful that all nuts, bolts, and screws in the mechanism or telescope have been properly set up.

92. The men in the gun- and turret-crews should be sufficiently instructed in the care of the sight and mechanism properly to impress them with the reasons for avoiding rough handling of any part of the sight-gear, and the reason for avoiding the use of gritty substances on any part of the telescope-lenses, or mechanism.

93. Setting sights.—Directions for setting the sight should come from the officer in charge of the fire-control, through the division-officer or gun-captain. Under no circumstances should the sight-setter be permitted to make his own allowances. In shrapnel fire the sight-setter will, when directed, instruct the shellman how to set or cut fuses. The sight-setter should keep his right hand on the elevating (range) wheel, and his left hand on the azimuth wheel (or vice versa), that he may carry out continuous sight-setting.

94. Setting training-sights.—All new telescope-sights for the larger hand-power guns will be cross-connected so that the sight-bars and deflection-scales of each sight will always be at the same reading, but with sights that are not cross-connected, it is not necessary to keep the training-sight very accurately set in elevation; all that is required is that the target, or point of aim, be reasonably near the center of the field of the training-telescope. For example, if at target-practice on training-ranges, it is sufficiently accurate to use the mean range on the trainer's sight. In action the trainer's sight should be kept accurately set for lateral compensation and approximately set for range. The latter can be accomplished by the trainer changing his sight-bar setting, with his disengaged hand, without observing the sight-bar scale, so as to bring the point of aim in the center of his field when the elevating pointer is on. This can be done by using the right hand for setting the sight in elevation and the left hand for training, which is perfectly feasible with practice. With the open-sight the trainer should become accustomed to taking the same kind of a sight at all times, keeping his sight set in elevation as above described.

95. (1) Night-sights.—Auxiliary peep-sights are fitted alongside of the telescope on recent sight-mounts. These are for use at night if the telescope cannot be advantageously used, and are

also intended for auxiliary use during daylight, in case of accident to the telescope.

(2) Various other forms of night-sights of older types are in service, detailed descriptions of which are unnecessary, as the peep is, next to the telescope, the most efficient form of sight. In using the peep at night a larger hole should be in the diaphragm than in day-firing, to admit as much light as the pupil of the eye is capable of receiving. The cross-wires are illuminated by light, from a small incandescent bulb, thrown on their intersection.

(3) The results of recent experimental night-work, both on the Asiatic and North Atlantic Stations, at actual target-practice, sub-caliber practice and at visibility tests of torpedo-boats under various conditions, demonstrate conclusively the superiority of the telescope over the ordinary open-sight for night use, either with or without search-lights. Opinions vary greatly as to the most suitable power for night-work, but a telescope of from 3- to 4-power seems from present experience to be preferable. The above experiments did not embrace the latest form of peep-sight, but it is safe to say that with an illuminated target and visible cross-wires a telescope of from 3- to 4-power is superior for night use to any other form of sight. Telescope-sights are of course useless unless the cross-wires are readily visible. The tentative trials showed that they can be made visible by throwing light upon them, up through a hole in the barrel, or by throwing light on the object-glass of the telescope. The latter method is good only as a makeshift, as the light would probably be visible from the outside.

(4) The wires of a telescope are usually visible without special illumination, if the telescope is pointed at an illuminated target, or in the beam of a search-light.

(5) Regular batteries are supplied for the various forms of night-sights which are fitted, and the lights for illuminating the scales on the sights are taken from these batteries.

ELECTRIC FIRING-ATTACHMENTS.

96. (1) The firing-batteries are composed of dry cells. These deteriorate with age; this is true of cells that are in storage as well as those that are in use. The batteries should be frequently tested with a voltmeter, the various parts of the circuit with a battery-tester, and the circuit as a whole with an ammeter or by firing a primer. Unless the electric firing-connections are perfect and securely held in place, there will be frequent failures to fire due to insufficient current passing through the primer.

(2) **The best test** (and the only sure one) of the electric firing-connections and battery-strength is the frequent firing of primers. The battery-tester, ammeter, and voltmeter are mainly useful in locating faults.

(3) **The faults** most frequently found in the circuit are broken wires or grease or other foreign matter in the connections. The firing of the gun will sometimes jar out the plugs and as it is very important that this should not occur, it is always advisable to put in set-screws. Particular care must be taken to see that both the primer-seat, the primer and all the contacts are kept perfectly clean and free from grease or oil. Whenever there is danger of a short circuit, the part should be covered with insulating tape.

(4) If no battery-tester is at hand, the firing-circuit can be quickly tested by using a key, knife, or any small piece of metal. Place the key, or the blade of the knife, in the spring-socket and the metal handle to the end of the tongue, then place one hand on the gun to complete the circuit, and have some one press the firing-key. If the circuit is all right for firing, a slight tingle will be felt on the tongue.

(5) **A failure of the primer to fire**, when using electric firing, is almost invariably caused by poor contacts. Batteries do, of course, deteriorate with time, and if short-circuited they will run down, but it must be remembered that a battery which is in good condition never gives out suddenly. There is no possibility of a battery which tests properly in the morning, failing in the afternoon through deterioration. A battery will fire thousands of primers before it is exhausted, and will fire hundreds, more rapidly than any gun can be fired, without showing any material loss of strength. Consequently, if reasonable care is taken to watch the batteries and test them before firing, it need never be feared that they are at fault in case of a miss-fire. Similarly, there is almost a certainty that the primer is all right, defective electric primers being very rare; therefore a primer miss-fire is probably due either to a broken connection or to excessive resistance such as oil, dirt, etc., in the circuit. In this latter case the fault is frequently improperly ascribed to a weak battery. It is an undoubted fact that many miss-fires occur in cases where a high voltage would fire the primer, but in all cases where there is no undue resistance such as oil, dirt, etc., in the circuit, the present battery will be found strong enough for the purpose.

97. (1) Be sure that the firing-lock is screwed all the way on the mushroom-stem, that is, until the spring-catch takes in its

slot. When the lock is screwed home, the edge of the mushroom-stem should be flush with the edge of the wedge-slot of the receiver. If the lock is not screwed home tightly, the primer-case will burst when the gun is fired, and the gases may fuse the primer-case and spike the vent. Locks should be tested for insulation between the firing-pin and the body of the lock. In some locks of older type the firing-pin spring has been found to be too strong, so that the main-spring fails to hold the firing-pin against the head of the primer. This may be remedied by cutting off a portion of the firing-pin spring and placing a washer behind the main-spring. In such cases the firing-pin should be shoved home after the wedge is closed.

(2) In case of a serious blow-back, shift the lock at once, and dismount and thoroughly examine it before using it again.

(3) **Locks** should be examined before using to see that the extractor is concentric, for, if the extractor is eccentric the lock will jam after a discharge.

(4) **The firing-pin** has been known to be driven back through its insulation by a blow-back, causing the block to stick, and short-circuiting the electrical connection, so that a failure to fire occurred at the next round. Sometimes a blow-back has bent the firing-pin, and has even blown the firing-pin out of the block with great force.

(5) **Burring** or deformation of the small idle-pinion is a frequent cause of locks being hard to open.

MISS-FIRES AND HANG-FIRES.

98. (1) The three following definitions are adopted as being necessary in order to make a clear distinction, by a single expression, between miss-fires (a) due to whatever cause, (b) due to a failure of the primer to explode, and (c) due to a failure of the charge to ignite on the explosion of the primer.

(2) *Miss-fire*.—A failure of the charge to explode, due to whatever cause, when an effort is made to fire a gun, either by pressing the firing-key, or pulling the lock-lanyard or trigger.

(3) *Primer-miss-fire*.—A miss-fire which is due to the failure of the primer to explode.

(4) *Charge-miss-fire*.—A miss-fire when the primer duly explodes, but fails to explode the charge.

99. (1) *Hang-fires*.—A hang-fire occurs when there is an appreciable interval between pressing the key, or pulling the trigger

or lanyard, and the explosion of the charge. This interval may be of long or short duration.

(2) Hang-fires are most frequently due to :

(a) Displaced ignition-charge, which prevents the flame from the primer impinging directly on the black powder.

(b) Ignition-charge wet, or (owing to it having been wet) caked and deteriorated.

(3) With heavy guns, hang-fires have been recorded of more than five minutes duration. With rapid-fire guns, hang-fires are usually not more than a few seconds in duration, but one case is recorded of a hang-fire of seven minutes duration in a 3-inch R. F. gun. This was due to a misplaced ignition-charge. When a miss-fire occurs, unless it is definitely known, by an examination of the extracted primer, that it was a primer-miss-fire, very great care is necessary, because in any case of a miss-fire, a hang-fire is always possible, and if the breech is opened its effects may be disastrous.

(4) The importance of exercising special precautions in the case of a miss-fire is forcibly exemplified by the accident on H. M. S. Mars on April 14, 1902, due to opening the breech of a 12-inch gun four minutes after a failure to fire.

Description of Locks and Primers as now Fitted.

100. (1) All primers now being issued for B. L. rifles are either electric or percussion (not "combination"), and all locks on B. L. rifles are combination, electric, and percussion locks.

(2) All primers for 4-, 5-, and 6-inch R. F. guns are combination, electric, and percussion, but some locks are combination, electric and percussion, while others are interchangeable, electric or percussion.

(3) All guns of 3-inch caliber and below are fitted with percussion locks and percussion primers only.

(4) The following rules apply to each distinctive type enumerated in paragraphs (1), (2) and (3).

(5) These rules are drawn up on the following general principles :

(a) That every effort is to be made to fire the gun as soon as possible after a miss-fire, thus avoiding the delay necessitated by the danger from a possible hang-fire.

(b) That none of the means taken to lessen the delay due to a miss-fire shall involve any risk of an accident due to unlocking the breech-plug during a possible hang-fire.

(6) Should the pointer press the firing-key, or pull the lock-lanyard, and the gun fail to fire immediately, he shall at once call "Miss-fire." The gun shall be kept laid on the target and the crew stand clear to avoid danger in case of a hang-fire.

Miss-Fires with Guns using B. L. Primers.

101. (1) **Electric firing.**—The division-officer may use his discretion, selecting whichever of the following courses of procedure he deems most probable to fire the particular gun in question with the least loss of time. He may either—

- (a) Press home all connections and try again, or
- (b) Insert a new electric primer and try again, after pressing home connections, or
- (c) Insert a percussion primer and fire by percussion.

(2) **Percussion firing.**—The division-officer must use his discretion. He may either—

- (a) Cock lock (using tool, for turret-guns) and try again.
- (b) Insert a new percussion primer and try again.

NOTE.—As percussion firing is usually not employed until electric gear is deranged, this latter is the most natural course to pursue.

- (c) If electric mechanism is intact, insert an electric primer and try by electricity.
- (3) *Continue to fire primers* as long as there is believed to be any probability of igniting the charge. If then the gun fails to fire, wait 20 minutes, after the last miss-fire, before opening the breech.

102. Miss-fires with 4-, 5- and 6-inch R. F. guns.—(See pages 91 and 92.)

Miss-fires with 4-, 5- and 6-inch R. F. guns.

(1) COMBINATION LOCKS AND COMBINATION PRIMERS.

Miss-fire. Electric.	Cock lock immediately and try percussion. If it	Fires	Examine connections carefully while reloading, and use electric on next shot. If it	Fires	Connections are intact. Continue electric firing.
		Miss-fires.		Miss-fires.	Use percussion thereafter, unless fault is surely detected.
Miss-fire. Percus- sion.	It is probable that the primer fired by electricity. Look out for a hang-fire. Cock lock, and again try by percussion. If it	Fires	Examine lock and all connections while reloading. Try electric again.	Miss-fires.	Try several times both by percussion and electricity. Wait 20 minutes from last trial. Open breech. Insert new cartridge-case; examine connections carefully, and try by electricity.
		If percussion firing is being used, electric is supposed to be out of order, hence try several times (if gun can be cocked without unlocking breech-plug). Wait 20 minutes from last trial. Reload. Examine, and if necessary shift lock, and continue.			

Miss-fires with 4-, 5- and 6-inch R. F. guns.

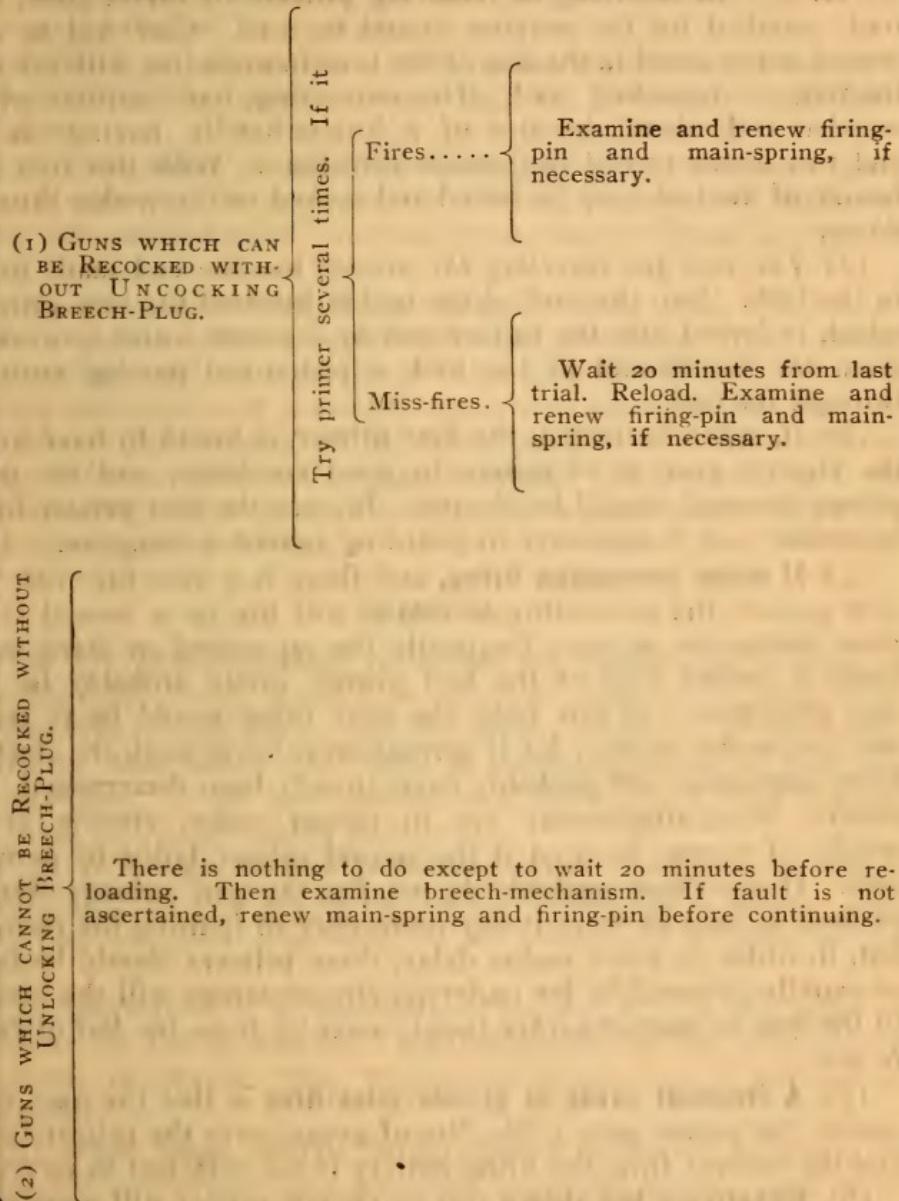
(2) INTECHANGEABLE LOCKS, USING COMBINATION PRIMERS.
NOTE.—Some of these guns have been fitted on board ship, so that fire may be quickly shifted from electric to percussion, without opening the breech. Such guns will follow the method laid down for combination locks, using combination primers (See page 91).

Miss-fire. Electric.	Fires.....	Examine all contacts and try again, holding key closed several seconds. If it	Examine, clean and secure all contacts, while reloading, and continue electric firing.
	Miss-fires..		Re-examine all contacts, test circuit as far as possible. If gun will not fire on repeated trials, wait 20 minutes from last trial before opening breech. Then open breech, remove cartridge-case, examine firing-pin. When in proper condition, insert another cartridge and fire electrically.
Miss-fire. Percussion.	Fires.....	If gun has been fitted to cock without unlocking breech, try several times.	Examine and, if necessary, renew firing-pin and main-spring while reloading.
	Miss-fires..		Wait 20 minutes from last trial, examine mechanism. Renew main-spring and firing-pin, if necessary. Reload and fire again.

NOTE.—If the gun has not been fitted either to cock, or to fire electrically, without unlocking breech, there is nothing to do but wait 20 minutes before opening it, then reload, examine breech-mechanism, and if the fault is not discovered, shift main-spring and firing-pin before continuing the fire.

103. Miss-fires with guns of 3-inch caliber or below.

NOTE.—These guns use percussion locks and primers only.



NOTE.—There are two types of breech-mechanism for the 3" R. F. G. One of these can be recocked without unlocking the plug; the other (The American Ordnance Co's design—Mark II) cannot be recocked without unlocking the plug, and hence falls under the second of the above classes.

Remarks on Above Tables.

104. (1) In inserting or removing primers of turret-guns, the tools supplied for the purpose should be used. Care will be observed not to stand in the line of the breech, or in line with the extracting or reloading tool. The extracting tool consists of a wooden rod, about the size of a broom-handle, having on its end two hooks turned in opposite directions. With this tool the handle of the lock may be seized and cocked or the wedge thrown down.

(2) *The tool for inserting the primer* has the end made to fit in the lock. Into this end of the tool is inserted the new primer, which is forced into the primer-seat by a piston which is worked from the handle-end of the tool, a piston-rod passing entirely through the tool.

(3) If, when extracted, the first primer is found to have fired, the electric gear is of course in good condition, and the next primer inserted should be electric. In case the first primer fires, particular care is necessary in guarding against a hang-fire.

(4) *If using percussion firing*, and there is a miss-fire with the first primer, the probability is that it will fire on a second trial, since percussion primers frequently fire on second or third trial, hence a second trial of the first primer would probably be the best procedure. If this fails, the next thing would be to try a new percussion primer, for if percussion is being used, the electric firing-appliances will probably have already been disarranged. If electric firing-attachments are in proper order, electric firing would, of course, be used if the second primer failed by percussion. If the above methods do not fire the gun, primers should be fired as long as there is any probability of igniting the charge; but, in order to avoid undue delay, these primers should be fired as rapidly as possible, for under no circumstances will the breech of the gun be opened *within twenty minutes from the last attempt to fire*.

(5) *A frequent cause of primer-miss-fires* is that the man who inserts the primer gets a thin film of grease over the primer-head, and the current from the firing-battery is not sufficient to pierce it.

(6) *Experience has shown* that an electric primer will sometimes fire if the key is held closed a few seconds, though it would not fire instantaneously, owing to resistance in the circuit.

(7) *Another cause of miss-fires*, observed with guns using B. L. primers, is that an empty primer-case is sometimes inserted by mistake.

(8) With electric firing the fault is usually in a broken connection or imperfect contact, due to dirt, etc. If terminals are efficiently secured by set-screws, the fault will probably be found in some of the lock connections.

(9) With percussion fire a primer-miss-fire is usually due to a broken firing-pin, weak main-spring, or dirt under firing-pin shoulder.

(10) Care must be observed when cocking a Hotchkiss gun, after a miss-fire, not to open the breech. Some small rapid-fire guns are supplied with recocking tools, which should always be used.

(11) When percussion firing alone is being used with R. F. guns, the instructions require that the primer be tried several times, while waiting, since there is nothing else that can be done during the wait, and these primers will frequently fire only on second or third impact of the firing-pin. If it is impossible to cock the lock without unlocking the breech, there is nothing to do but wait until the required twenty minutes have elapsed *after the last attempt to fire.*

PRIMERS.

105. (1) It is important to extract the primer-case as soon as possible after firing, while it is still hot, otherwise it may stick. If the primer-case sticks, use the hand-extractor. If the hand-extractor fails, screw lock back on mushroom-stem to start the primer-case. If the lock screws back hard, tap it with a block of wood or wooden mallet to start it.

(2) The primer should be inserted after the breech is closed and locked, but just before the electric connection is made. This prevents the gun being fired before everybody is clear of the recoil.

(3) Lubrication of primer-seat.—By using a very thin layer of graphite in the primer-seat the extraction of the primer-case is much facilitated. One application serves for a number of discharges.

(4) When using electric firing, should it become necessary to extract a live primer, the plugman starts the breech open so as to break the electric connection, the loader extracts the primer, using great care to avoid firing it.

(5) When using percussion firing, should it become necessary to extract a live primer after the lock is cocked, the turret-officer will caution the crew and pointer to avoid touching the lock-

lanyard, then the designated member of the crew will grasp the handle of the lock firmly with the right hand and pull it directly to the rear until it brings up against the stop; with the left hand unhook the lock-lanyard, keeping the hammer pulled back all the time with the right hand on the handle, drop the lanyard, and, with the forefinger and thumb of the left hand, pull back the trigger; hold it back and gently ease down the hammer with the right hand, twisting all the time to the left (against the hands of a watch), until the handle turns to the left and extracts the primer without allowing the hammer to rest against the firing-pin.

106. (1) Attention is invited to Dept. Special Order No. 28, of August 28, 1902, and North Atlantic Fleet General Order No. 4, of February 3, 1903, relating to inserting the primer in guns using B. L. Primers. These may be summarized as follows:

(2) "Hereafter the practice of inserting the primer in breech-loading guns, using B. L. primers, while the breech is open is to be discontinued and the breech-plugs must be closed and locked before the primer is inserted in the firing-lock, except in the case of 5-inch and 6-inch, 50-caliber guns, in which the firing-pin is in a safe position until the breech is locked. (Dept. S. O. No. 28, of August 28, 1902.)

(3) "In guns using B. L. primers, the breech will not be opened with a live primer in the lock.

(4) "*The lock-lanyard will never be hooked to the trigger of the lock except when using the percussion firing-mechanism, and then only after the breech is closed and just before cocking the lock.*

(5) "*The gun-crews should be frequently drilled in the manipulation of the firing-mechanism in order that rapid firing may be attained with safety.*"

PRECAUTIONS AGAINST FLARE-BACKS.

107. (1) Precaution when firing both guns of a turret.—When firing both guns of a turret with the present powder, which leaves a combustible, gaseous residuum, the breech of the gun shall not be opened after firing if powder is exposed in the operation of loading the other guns. This precaution is unnecessary with turrets which are fitted with thoroughly tested and officially approved appliances for blowing the gases out of the gun.

(2) The following Special Order, No. 44, Oct. 31, 1903, invites attention to the danger resulting from flare-backs:

"The attention of the commanding officers and of all officers and others in charge of guns is directed to the danger from the issue of

flaming gases from the breech of large guns when opened quickly after firing. Instances during recent target-practice have been reported where, upon opening the breech to load, flames have issued forth of such volume and temperature that the hair and clothing of members of the gun's crew were singed and scorched. This was observed to be specially liable to occur when firing to windward in a strong breeze.

" Whenever the conditions are such as to create a probability of accident from this cause, the commanding officer and those in charge of the gun will carefully guard against accidental ignition of the powder-charges in the vicinity of the gun; and in turret-guns, when firing into the wind, special caution must be observed not to hoist a charge for the next round above the turret floor until the breech is open and danger of ignition by flames from the breech has disappeared."

(3) In connection with the above order, the following extracts from the report of the court of inquiry on the explosion in the after-turret of the U. S. S. Missouri, April 13, 1904, is quoted, as giving later information on the subject of flare-backs:

" The court finds . . . that the cause of said accident was the unexpected ignition of the two sections of the charge of smokeless powder then in the gun, by what it termed throughout the proceedings, a 'flare-back,' a flame resulting from the ignition in some manner not yet known, of residual gases attendant upon the combustion of the smokeless powder now in use."

" The evidence shows that the rapidity of fire does not seem to affect its (the flare-back's) occurrence, but appears to increase the volume of the flame; that a flare-back rarely appears immediately after the first shot, though one turret-officer observed a very severe one when loading after first shot; this one occurred after the shell had been rammed in the gun; the bag of the smokeless powder-charge, which was to the rear of the gun in its loading-car, was scorched; that the direction of the wind does not affect the occurrence of the flare-back, except to delay its appearance when the wind is blowing in the direction of the target and vice versa."

(4) Air-blasts are now being fitted to all heavy turret-guns, to clear the bore of inflammable gases, but as some of the older turrets may not be so fitted immediately, every turret should be provided with an improvised air-blast fed from the accumulator. As stated in Special Order No. 57, of May 31, 1904, quoted below, the use of the combined sponge and rammer is a sufficient safeguard in the case of broadside-guns which do not use a cartridge-case. R. F. guns (using cartridge-case) require no special precautions.

" Supplementing Special Order No. 44, dated October 31, last, the following instructions are issued for the guidance of the naval service:

" 1. Recent experience in target-practice has demonstrated that there is present in the chamber of all guns an inflammable gas which, under certain conditions, may constitute a danger in igniting the exposed charge while the gun is being loaded for the next round.

" 2. The sponging of all broadside B. L. guns using cartridges that are unprotected by metal cases is deemed to be necessary. In case of guns of this class, the combined sponge and rammer will be used, with the bristle-head dampened with water. The sponge will be entered in the chamber immediately following the shell, and will be shoved home as far as the shell, when seated, will permit, and then will be withdrawn. When the gun is sponged in this manner, it is not possible for inflammable gases or bits of burning powder-bags to remain in the powder-chamber to endanger the ignition of the charge.

" 3. In the case of large-caliber guns, where sponging the chamber is impracticable, the danger from 'flare-backs,' or from the presence of inflammable gases or bits of burning material in the bore after firing, must be avoided by making sure that all parts of the bore are clear, before the charge for the succeeding round is hoisted above the turret floor. In order to make sure that all danger of a premature ignition of a charge while being loaded has passed, a sufficient interval of time must be allowed to elapse, after the breech-plug is opened, for the gas and smoke in the chamber and bore to dissipate; and the ammunition-car shall not be hoisted to the loading position until after it has been determined, by a careful inspection, that no burning residue remains in the chamber, and that a clear view through the gun shows the chamber and bore to be free of gas.

" 4. When adequate mechanical means have been fitted for the purpose of promptly clearing the chamber and bore of all gas, fragments of powder-bags, etc., and when, after satisfactory trials, the same shall have been approved officially by the Department, the foregoing precautions may be dispensed with; but in no case will any of the precautions be omitted while using any extemporized blowing appliance, or when the approved appliance is not working at the standard pressure for which it was designed.

" 5. The sponging of guns using fixed ammunition, where the cartridge-bag is protected by metal cases, is not deemed to be necessary, but, before stowing the empty cartridge-cases below, steps must be taken to free them from all inflammable gases. This can best be done by laying the cases on their sides, and by testing each one for the presence of gases, by inserting a lighted taper in each case as far as the bottom, thus setting fire to any inflammable gases, consuming them.

" 6. Under no circumstances shall the material of the cartridge-bags or strengthening tapes be added to without authority. Should it be necessary to stiffen the charges, additional tapes will not be used, but, if necessary, the old tapes will be retied or replaced by new tape.

" 7. The magazine flap-doors of only such magazines as are being used to supply charges shall be open, the flaps, in all cases, being down except during the time of actual passage of the sections of the charge through the door.

" 8. There shall not be exposed (removed from the tanks) at one time in all the magazines in use, more than one charge for each ammunition hoist, and then only as necessary to supply the demand in the handling-room; nor shall there be permitted at any time an accumulation of exposed sections for more than one charge for each ammunition-hoist outside the magazines in the handling-room.

" 9. A copy of this order shall be posted in every turret, and commanding officers of all vessels, in acknowledging receipt of the order, will report that this provision has been complied with and that all line officers attached to the vessel have noted and initialed the order."

GAS-CHECKS.

108. (1) With each gun there are issued spare gas-check pads and spare gas-check rings. These pads and rings are carefully fitted to the guns and are not likely to give any serious trouble.

(2) In fitting a new set of gas-check rings or gas-check pads, they should be very carefully adjusted. The bearing of the rings and pad in the gas-check seat should be verified by making chalk marks, parallel to the axis of the bore, in the gas-check seat, closing the breech, then opening it, and noting the marks transferred to rings and pad.

(3) **The life of a pad** is variable. The gas-check pad and rings should be protected from the weather and everything that could indent or bruise them. The rings and gas-check seat should be kept scrupulously clean and well oiled, using soft rags or pieces of waste. Neither the rings nor gas-check seat should be cleaned with any gritty substance, nor should they ever be touched with a file or emery cloth, except in extreme cases to remove a burr or score, which must always be done in the presence of an officer; for, to insure proper checking, these rings must be a most accurate fit. The pad should be habitually coated with tallow and, after firing, the mushroom and gas-check should be dismounted, cleaned and oiled as soon as possible.

(4) **As the pad is liable to be injured** in spite of all precautions, it becomes important to know how serious such injuries are. The pad will perform its function, in spite of almost any amount of bruising, if its circumference is intact, even though it has lost a portion of its filling. An exception may be found to this statement in cold weather, when, by the hardening of the pad, its plasticity is much reduced. An injured pad should be replaced, however, if time permits.

(5) **With the latest form of gas-check**, the nuts on the mushroom-stem should be set up moderately tight and left so. There is very little chance of the pad or rings sticking.

(6) **If necessary to fire with a defective pad**, give the circumference of the pad a thick coating of tallow before firing. If, after firing, a pad is found to be scored or burned, the front gas-check ring is not functioning properly and should be carefully examined for fit and for scoring, and, if defective, replaced by a perfect one.

(7) **During practice** the pad and mushroom-head should frequently be sponged off with fresh water.

(8) **If a pad becomes very hard**, soak it in a hot mixture of oil and tallow.

(9) **If the canvas covering** of a pad appears to be slack at any time, the pad should be rejected.

(10) **The inspection of the gas-check** by the plugman is to see that the rings and pad are properly adjusted, and that the nuts on the mushroom are set at the proper tension. Care should be taken that the pad and rings have not dropped down, as may be the case if the nuts on the mushroom-stem are not set up tight enough. The adjustment is correct if the plugman can just turn the mushroom-head, using both hands, and if the pad is smooth

and intact all around, the rings being flush with it and the plug proper.

MISCELLANEOUS NOTES.

Accessories and Minor Spare Parts.

109. (1) The gunner's-mate of a turret-gun will issue, or keep in the turret ready for use, in racks or in a locker, when practicable, the following articles:

Lubricants,	Marine-sponges (for each gun),
Tallow,	Bristle chamber-sponge,
Waste,	Bristle bore-sponge,
Two spare locks fitted with firing-wire,	Sheepskin sponges,
Two lock-lanyards (for each gun),	Rope straps,
Primers,	Dismounting-tackle for mushroom-head,
Priming-wires,	Differential-purchase,
Boring-bit,	Wrenches for gun-mount,
Wrenches for breech-mechanism,	Cold-chisels,
Two spare gas-check pads,	Hammer,
Vent-drill,	Screw-drivers,
Vent-cleaner,	Monkey-wrenches,
Wooden cleaner,	Stilson-wrenches,
Wooden maul,	Screw-jack,
Drill-brace,	Spare packing,
Two hand-primer extractors,	Files (half round and flat),
Copper maul,	Such spare parts as are provided,
Copper drift-pins,	Spare loading-tray,
Sheet copper,	Material for wiping off sights,
Medical emergency-box,	One spare electrical firing-wire,
Wooden blocking,	Iron wedges,
Wooden wedges,	Wrenches for the mount,
Pinch-bar,	Tourniquets,
Shell-extractor,	First-aid packages,
	Bag of sand.

(2) The gunner's-mate of a division of broadside guns will keep in his chest ready for use, or provide and have at hand, such of the above articles as may be supplied for the guns of his division. He also issues sights, firing-attachments, fuse-cutters (if used), and all necessary accessories.

Heavy Accessories and Spare Parts, etc.

110. (1) A list of the accessories and minor spare parts which are supplied by the gunner's-mates will be found in the above paragraph. The gun-crew will be made familiar with the use of all such gear and will also be instructed as to the stowage of other spare gear which is not supplied by the gunner's-mate.

(2) **Spare parts** are supplied to ships not only for the minor portions of breech-mechanism, sights, etc., but for nearly every principal part of the gun-mount. At *Clear Ship for Action* these spare parts should be placed at a previously designated position, convenient to the battery but so removed that no danger would accrue therefrom to the personnel. The drill should include the shifting of these parts (such parts of guns or mounts as would be deranged by a bursting shell), by commands such as *Gun No. —, elevating gear demolished!* or *Training rack injured!* The smaller parts will also be shifted at drill, since derangement of breech-mechanism, firing-pins, etc., may be expected in action.

(3) Means should always be at hand at general quarters for promptly shifting every part of the gun-mount, but unless the spare parts are permanently stowed near the guns, they will be obtained from the storeroom when required at ordinary general quarters, because at such drills it is possible to obtain these more permanent spare parts from the storeroom while removing the injured part. It is preferable, however, to arrange such spare parts permanently in brackets on bulkheads convenient to but removed from the guns. In this case they do not have to be specially provided at *Clear Ship for Action*. In turret-guns these heavy spare parts should be kept permanently on brackets on bulkheads in the handling-rooms, so that they can be sent up on the car the moment they are required.

(4) This shifting of parts should be introduced into the drill only after the crews have become expert in the actual service of the gun, but it is nevertheless an important feature of preparation for action.

(5) In case of derangement of the training-mechanism to such an extent that it cannot be replaced by the spare gear, two training tackles led from each side of a gun, manned and carefully handled will permit an otherwise disabled gun to continue firing. To use these tackles it is of course necessary to throw out the training-gear. Two tackles for each division using broadside guns should

therefore be provided at *Clear Ship for Action*, and placed at some convenient point removed from the personnel.

Care and Preservation of Ordnance Outfit.

(1) As the satisfactory performance of mechanical gun-carriages, breech-loading rifles, rapid-fire and machine-guns, depends in a great measure upon the condition in which they are kept, it is directed that the greatest care and attention be given to keep all parts perfectly clean, properly lubricated and in thoroughly good working order.

(2) All breech-mechanism must be cleaned daily, avoiding the use of any gritty substance. The breech-plug must be frequently removed from the tray in order that the bottom threads may be reached for cleaning.

(3) Brick-dust or gritty substances must never be used on any part of the gun.

(4) The parts of the mechanism must never be scraped with knives or metal scrapers, or be defaced or roughened in any way.

(5) All parts of the gun must be kept lightly oiled as a protection against rust.

(6) The guns should be carefully washed out with fresh water after every firing, using the bristle-bore and chamber-sponge. The muzzle should be depressed for this purpose. If a hose is available, it will be found very efficient, and its use will save the sponges.

(7) The bore and chamber should be carefully dried with the sheepskin sponges and finally thoroughly oiled by passing through them several times a sheepskin sponge well coated with oil.

(8) Particular attention should be given to keeping the slope and the origin of rifling well oiled and free from rust.

(9) After firing guns of 6-inch caliber and below, completely dismount the breech-mechanism and wash every part with warm fresh water and soap; dry them carefully, then rub all parts with a well-oiled rag, and assemble the mechanism.

(10) Keep rapid-fire and machine-guns covered whenever there is a chance of getting coal-dust, grit, or salt water on them. Inspect and re-oil the guns once a week. In re-oiling, first wipe off all the old oil, which may have become clogged with dust and grit.

(11) If the guns are closed by tompions, these should be withdrawn every fair day, and the compression slopes cleaned and re-oiled.

(12) The gas-checks should be protected, as far as possible, from the weather and from everything which could indent or bruise the pads. The rings or discs should be kept scrupulously clean and well oiled, and the pads should be habitually coated with tallow. After battery practice, the mushroom and gas-check should be removed, cleaned and oiled as soon as practicable.

(13) The pads, rings and discs should, when practicable, and especially in bad weather at sea, be removed, cleaned, dried and oiled, and be kept in such place as is appointed for them.

(14) All axles, such as those of trucks, elevating- and training-gear, yoke- and pivot-bolts, elevating-arc bolts, etc., are to be taken out, cleaned and oiled once in two months, or oftener if circumstances render it necessary.

(15) The ball-bearings and friction-rollers of R. F. mounts should be kept clean and lightly oiled in order to prevent rusting. The oil-channels in the slide of a R. F. mount must be kept clear of dirt, and should be filled with oil before the gun is fired.

(16) "It having been found that many of the guns returned from auxiliary vessels are badly rusted at the part going in the recoil-slide, and that sliding surfaces which should be clean and bright are thickly covered with paint, and that roller-bearings are badly rusted and oil-holes stopped up, the Department directs that the following precautions be observed with regard to 4-inch, 5-inch, and 6-inch pedestal mounts:

(17) All 4-inch, 5-inch, 6-inch, and 8-inch slides must be oiled at least once a week and the gun moved in the slide, unless the vessel is at sea and this is impracticable. Guns are not to be painted in rear of slide, over that portion passed by the strengthening-band in firing, as is the case in 4-inch and 5-inch guns. The roller-paths must be oiled once a week, and the top-carriage raised and rollers taken out and cleaned at least once a month. Oil-holes must be kept clear and closed in wet weather. Training- and elevating-gear must be kept clean and all steel parts well oiled. For this purpose they must be removed at least once a month."

(18) Compressors.—In mounts of the latest types, compressors are furnished for use in removing and replacing the counter-recoil springs. They screw on the ends of the piston-rods and their flanges take against the rear bonnets of the recoil-cylinders. When it becomes necessary to remove the counter-recoil springs, take off the two piston-rod nuts and ease the gun to the position of full recoil.

(19) **Piston-rods** must be kept free from rust, but the use of emery or brick-dust for this purpose is never to be allowed, except where necessary to remove rust that has unavoidably formed.

(20) As a rule, emery is to be used only by trained men.

(21) A liberal amount of cleaning materials is furnished, but the allowance is the necessary reasonable amount required for keeping the working parts in good order, depending upon the climate and vicissitudes of service.

(22) **Lard-oil** should never be used on any part of a gun's mechanism, as it hardens in cold weather. Mineral- or fish-oil is better, but vaseline is best.

(23) **Friction-discs of intermediate-battery guns.**—Friction-discs should be kept clean and perfectly free from oil or other lubricant. Washing in lye-water and then thoroughly rinsing in fresh water will remove any accumulation of oil or grease. In discs of the multiple type it has been found that one man, using a twenty-four inch wrench, can set them up sufficiently hard.

(24) **Electric contacts in turrets.**—The commutators and brushes of all motors, circuit-breakers, connections, and contacts of switches and controllers should be examined frequently, and if necessary smoothed with a file and emery cloth to keep the contact surfaces intact.

Casualties.

112. (1) It must be remembered that intelligent inter-cooperation between individual members of a gun-crew is vitally necessary for the efficient service of a gun, especially after the crew has been reduced by casualties.

(2) The various drills given in this book are made out for the least number of men required to obtain the maximum efficiency from the various guns and mountings dealt with, but when casualties occur in the crew, the original rate of fire will necessarily be lessened. The extent to which the rate of fire is actually lessened depends entirely upon the capacity of the remaining numbers to absorb between them the duties which belong properly to those who have been removed.

(3) Though general rules have been laid down requiring each man of a crew to be trained at two stations, and stating in a general manner how the service of the gun would continue, special instructions should be given to each gun-crew in casualty drill, calling off certain men as casualties, until the crew is able to continue a rapid fire with a reduced number of men.

(4) A general provision similar to the above is necessary, as all men are not of equal physique, and the consequent increase of work thus thrown on certain men may tell more on some than on others, especially in prolonged fire.

(5) It is on this account that each member of a diminished gun-crew must be constantly on the alert to detect any fault or delay, and to at once remedy it in whatever manner may seem to best expedite the service of the gun.

(6) Although these instructions have not provided for the service of a gun when the crew is reduced to a very small number, it must be borne in mind that no gun is to be abandoned, even by the last remaining man, as long as it can be loaded and fired, no matter how slowly, as one shot may decide an action.

(7) For the above reasons, every man in a well-trained gun-crew should be familiar with the duties of every other station, and should be prepared to perform them without hesitation.

(8) *The removal of casualties* is a matter to be specially provided for in each ship. This point is fully covered in Part I, Art. 27, and Part III, Arts. 95 to 103, where it will be seen that the removal of the wounded is primarily the duty of the relief-station crews, assisted, when directed, by the reserve gun-crews. It is the duty of the gun-crew to continue the service of the gun, and to overcome every obstacle which interferes therewith. The gun-crew will therefore not cease their operations of loading, but two men nearest to the wounded man should, without orders, place him in any convenient position clear of the working of the gun, whence he will be removed and given first-aid treatment, as elsewhere specified. The operations of loading or firing will never be discontinued for the purpose of removing casualties, except in cases of absolute necessity.

SPECIAL NOTES ON TURRET MOUNTS.

TURRETS IN GENERAL.

113. (1) All parts of the turret, turret machinery, and gun fittings should be kept clean and free from rust.

(2) All working parts should be kept well lubricated. No fresh lubricant should be applied to any part without first removing the old coating and thoroughly cleaning the part. In case the coating is difficult to remove, it should be rubbed away with a rag saturated with kerosene. The use of scrapers is prohibited.

(3) Operating-levers, valves, valve-stems, rollers, roller-path, ammunition-hoist guides, ammunition-cars, rests, handling-room truck and turntable, shell-room trolleys and rails, should be kept clean and free from paint, and should be occasionally wiped with an oily rag to prevent rusting. These parts should not, however, be considered as brightwork.

(4) **The inside of the turret**, including the sides, the top and those platforms not ordinarily trod upon by the crew should be painted white—preferably with white gloss paint—in order to give as much light as possible. No colored paints should be allowed. The guns may either be painted white or they may be kept bright and burnished. Tools, racks and rails should be kept bright. After they are once gotten in condition they are easily maintained. If they are not prevented, the men in the turret will try to paint a little more, from time to time, until everything is covered. The slits in the sighting-hoods should be painted a medium shade of green, as should also a section of the turret roof in front of each telescope. Either asphaltum varnish, or brown zinc with plenty of drier in it, is a good coating for turret-platforms and floors, where oil or water is likely to drip.

(5) Particular attention should be observed to keep water and cinders out of the turret and handling-room. The minimum amount of oil necessary to keep steel work in good condition should be used in a turret.

(6) **The wire-fall** of the ammunition-hoist should be kept clean, with a slight coating of oil to preserve it. Paint a square-mark on the wire-falls at the height of the operating levers when the ammunition-car is on its rest in the handling-room; this enables the hoistman to tell when the car is nearly down on its rest, so he can land it gently. Much trouble comes from landing the cars too heavily on their rests, especially when they are filled with shell and powder, as the repeated blows

cause the rests to spring out of shape, in which case they will not clear the handling-room truck when the turret is turned. When this does happen the rests may be forced up clear of the handling-room truck by means of a screw-jack.

(7) In those turrets which still have three loading positions for the ammunition-car, it is a good plan to paint white the three teeth of each guide-rail which represent the three loading positions for the pawls.

(8) Ammunition-hoists should always be worked at a *steady and regular speed*.

(9) As the wire rope stretches, the slack must be taken up and the hoist tested to see that the automatic "cut-off" stops the motor, before the car can strike the block at the turret roof. It is also necessary to remove slack from a stretched wire rope in order to avoid getting kinks in it. A stranded, or badly rusted wire rope should be immediately replaced.

114. (1) **The crank** should be left shipped for all ordinary firing. If firing at extreme elevation it may, in some turrets, be necessary to unship it before firing the gun.

(2) Occasionally when the breech-plug is closed with too much force, the rear end of the plug is lifted slightly in the screw-box by the spiral-pinion, so that the axis of the plug is not in line with the axis of the bore. Consequently, the teeth of the unlocking-rack will bear too hard on the spiral-pinion, and they are liable to injury when the gun is fired. This accident occurred on several ships during the bombardments at Santiago de Cuba. To avoid this, ease back slightly on the operating-crank after the plug is entirely closed, and if the plug has been lifted out of line it will be seen to drop down into its proper place. This slight motion of the crank will not be sufficient to separate the contact pieces of the firing-circuit.

115. (1) **Shafting.**—Many turrets have steel bearings for the shafting—especially the elevator shafting. At times the shaft will stick. In such a case never try to force the gear. If the shaft is removed it will frequently be found that a thread has been turned up on the shaft. There will generally be enough bearing surface left in the bearing to temporarily repair it by smoothing off the shaft and reaming out the bearing where the damage has been done.

(2) If the oil-grooves in the bearing surface are insufficient, cut new ones. All bearings should be made of soft metal, and after trouble has been experienced with them they should be so fitted, preferably at a navy yard.

(3) When a ship first goes into commission, a great deal too much power will be required to run the gear, and in electric turrets circuit-breakers will give trouble by frequent blowing. If the gear is run each morning, and used every day for Morris-tube practice this trouble will gradually decrease.

(4) The shafts of the hoist-drum are liable to be bent by the hoistman running the car against obstructions. These can usually be straightened on board ship.

116. (1) Organization.—When a ship goes into commission, a turret-captain, two gunner's-mates and an electrician (in the case of electric turrets) should be detailed for each 10-, 12-, and 13-inch turret. One good, ambitious young man should be detailed as assistant to each gunner's-mate. These men should keep the turret in good condition, and the other members of the crew should not be allowed in the turret except for drill, instruction, or other duty.

(2) **The turret-captain**, gunner's-mates, and their assistants should live in the turret, and one of them should always be required to be there. There should be no objection to these men making themselves as comfortable as possible therein, provided the efficiency of the gear is in no way impaired and the turret and handling-room kept clean and in order.

(3) **Gear in turrets.**—While it is particularly desirable that no unnecessary gear be allowed in the turret or beneath it in the handling-room, yet some tools are necessary, so that too many trips may not have to be made to the ordnance workshop. A small vise securely mounted in the turret is almost necessary, and besides this, various other tools, spare parts, and material. All of this material should be stowed in metal boxes, and as far as practicable under the floor-plating or in such places that a large shell striking the turret, or a small one exploding inside of it, would not be likely to displace them. All wrenches, etc., belonging to the turret should be so secured that a severe shock may not send them flying about. No articles should be secured to the walls of the turret.

(4) The assistants to the gunner's-mates should be considered to be in training for gunner's-mates, and should be selected with that object in view.

(5) As the men in the turret do the gun-brightwork for the entire division, and in addition usually clean compartments below the turret, they are kept busy and should, so far as possible, be excused from running-boat crews, anchor-watches, etc.

(6) As the assistants to the gunner's-mates get much experience in handling the turret-gear, they should, if not members of

the gun-pointer group, be detailed as hoistmen. In instructing men to run hoists they should be taught to watch the moving car as much as possible. This method trains them to run the gear faster and with a greater degree of precision.

(7) It will be found advantageous to look ahead for men to fill positions of plugmen, hoistmen, pointers, rammermen, and in fact all important positions. When only one gun fires at a time at target-practice, it is good training to have these men come in the turret when their crews are not working and become accustomed to the firing.

117. A smooth log should be kept by the turret-officer which should show that the gear has been run each day, what repairs have been made, the general work done, and the condition of turret and mechanism. It should also contain a record of target-practice and the names of men under instruction for pointers, gunner's-mates, hoistmen, etc. In fact, anything of interest. Turret-officers who have kept logs of this description have found it very useful.

118. (1) Owing to the angle of elevation at which the old types of guns are loaded, the projectile sometimes starts back from its seat after being properly set home; this is very easily and efficaciously remedied by means of two turns of a rope-yarn or other small stuff around the projectile, just forward of the compression-band.

(2) The sound will always tell the officer whether or not the shell is home. It is difficult to know by observation alone whether the projectile is fully home, and the hydraulic rammer does not indicate this. With mounts using electric chain-rammers, a mark may be placed on the last section of the rammer.

119. Instructions in regard to turret-sights will be found in the chapter on gun-sights.

120. During heavy weather at sea, watch the turret and keep the locks set well home to prevent any motion.

121. Do not attempt to enter the turret-locks when the turret is moving.

122. Before turning a turret, ease up on the holding-down springs of the water-shed, or raise the water-shed if practicable; see everything clear outside of and in wake of the guns and see everything clear in the handling-room.

123. Care must be taken that the front ends of the sections of the powder-charge do not catch between the hoist and rear face of gun; one of the crew should be detailed to guard against this; a wooden heaver is useful for guiding them to the loading-tray.

Difficulty is most likely to occur when the charge is in four sections, two of which will be inserted at one time.

124. The breech of the gun being raised by the gun-pointer, who cannot see from the sighting-hood whether the gun is loaded, primed, and ready for raising, he must be informed to that effect, and therefore the cautionary command **READY!** has been introduced. This is preferably replaced by a tap on the pointer's leg.

125. **The rollers and roller-paths** should be examined once a week by the turret-officer, who should assure himself of their cleanliness and freedom from rust; and before turning the turret, he should ascertain if the roller-path is clear of obstructions. The men should be cautioned not to leave tools, cleaning rags, or other implements on the roller-path. Much depends upon keeping the rollers and roller-paths smooth and clean. A light coating of oil will insure against rust. The training-racks should be kept free from rust, and be well coated with Albany grease or vaseline.

126. Any defect in the working of the turret-motors or engines should be promptly reported to the commanding officer. If one turning-engine or motor is disabled, it should be shut off, as the other one will suffice to train the turret at a moderate speed, unless the ship is very much heeled.

127. Loading by hand.—The turret should be supplied with gear for loading by hand. A short spar should be fitted with knotted lanyards, so that the men can give it a good swing through the powder-chamber. To load by hand, especially in a seaway, is a very difficult undertaking, as there is great danger of dropping a shell to the handling-room from the gun-platform. So far none of our turrets are fitted with proper gear to obviate this danger. A pinch-bar across the face of the breech should not be trusted. A steel chock should be placed across the breech and held firmly there (independently of assistance by one of the crew), by the breech-plug and the tray-latch catch so that the shell cannot displace it even where it strikes it with considerable force. The chock should be so arranged that when the shell starts to slip out of the gun it is gradually brought to rest by ascending an inclined plane, so that too much strain is not brought on the breech-plug or catch. The chock should admit of the spar-rammer being used; when it is in place, lower the ammunition-hoist, raise the breech of the gun to level or above, and then give the loading-spar a good swing and send the shell home.

128. (1) During hostilities it may be necessary to keep the guns loaded at times in anticipation of an immediate attack. In

such cases, while awaiting the attack, the electric contact at the breech-plug should be kept broken about one-fourth of an inch.

(2) When the attack is considered no longer imminent, the gun should be unloaded if practicable, and the powder returned to the magazine; the shell may be left in the car, if desirable. If the shell cannot be easily withdrawn it may be left in the bore for a few days if there is a probability of it being required during that period of time. In this case a wooden batten, equaling in length the distance between the base of the shell and the mushroom-head, should be placed in the powder-chamber to prevent the shell working to the rear against the plug.

(3) The shell should never be allowed to remain continuously in the bore for more than one week, if it is possible to withdraw it, on account of the liability of rust in the wake of the rotating-band, but in case this is absolutely necessary, oil should be introduced around the shell, both from the breech and from the muzzle.

(4) Though backing out a well-rammed shell is at times a difficult undertaking, this should not serve as an excuse for ramming it home gently under the above circumstances, for in that case it would probably give inaccurate results when fired (see Art. 137, Par. 4, Part II); and it is most important that erratic shots be eliminated, especially in the beginning of an engagement.

(5) Owing to the value of ammunition in war-time, the fact that the withdrawal of a shell is difficult, should not ordinarily be a sufficient cause for firing it for the sole purpose of clearing the bore. If the shell cannot be withdrawn, care in keeping the bore oiled in wake of the shell should, to a large extent, eliminate the danger of rust even if it is kept in place for several weeks.

(6) Powder-charges should never be kept in the turret or in the ammunition-car in such cases, as the change in temperature of that charge would probably insure a miss with that shot, and besides would render its value as a trial shot worthless and misleading.

(7) For the above reasons, if in anticipation of an immediate attack the gun has been completely loaded for 15 or 20 minutes, and the attack is still immediately imminent, the charge should be withdrawn and a new charge, fresh from the magazine, should be inserted.

129. Strap for mushroom.—It is well always to have at hand a net-strap which fits snugly over the mushroom-head, to use when shifting the gas-check pads. At high temperatures the gas-check

pads become soft and sometimes disintegrate after several rounds. The mushroom will be too hot to touch with the hands when shifting pads; and, therefore, the necessity for a strap fitted with a net to go over the mushroom-head, and also for a small tackle to take the weight. A gas-check pad can be shifted very quickly, even with a hot breech-plug. During action it is not necessary to shift a gas-check pad at the first sign of disintegration, as it will check the gas for a number of rounds after the rear wall of the turret has been spattered with asbestos and tallow;—but continue to set up on the adjusting nuts of the mushroom-stem after each shot, and shift the pad at the first opportunity. It must be borne in mind however that if too much of the pad be lost there is danger of bending the gas-check discs or rings.

130. (1) Before target-practice, or other firing, carefully clear all oil out of powder-chamber and from mushroom-head.

(2) After target-practice, or other firing, wash the gun out with the washing-out hose and bristle-bore sponge; then wash the bore thoroughly with fresh water, and after it is dry, give it a good coat of oil. The guns should be sponged and oiled once a week. Fit the bore-sponge with two lanyards for hauling it through the gun; cover it with a piece of old blanket and haul it back and forth until the bore is clean and dry; then wrap a piece of well-oiled blanket around a sponge-cylinder and haul it through to oil the bore.

131. The use of emery-cloth, brick-dust, or similar polishing material should be forbidden on the following named parts of the mounts :

Interior of valve-casings,
Piston-valves,
Valve-faces,
Adjusting-screws,
Elevating-worm,
Elevating-worm wheel,
Elevating-pinions,
Knife-edges,

Hardened plate on spring-bar of
knife-edge trunnion-bearing.
Telescope-sights,
Telescope-sighting mechanism,
Screw-thread on elevating-rod,
Piston-rods,
Rammer sections,
Sight-adjuster.

ELECTRIC TURRETS.

132. All electric-turret guns are fitted with recoil-cylinders (two or four in number), which are filled with a mixture of glycerine and water, and contain a piston, piston-rod, and counter-recoil springs. These guns return to battery automatically by action of the counter-recoil springs.

133. (1) **Waterproof motors** are now used exclusively in electric turrets. These should be examined periodically and kept clean, and their commutators wiped off, but as a general rule they should be left alone. Their bearings should be kept oiled at all times, and they should be cleaned once a month. Grease-cups on their bearings require less attention than oil-cups. Care must at all times be exercised that the wiring of the armature and field is not injured, and that it is kept free from paint.

(2) **Unship hand-cranks.**—Where the ammunition-car is fitted to be hoisted both by electricity and by hand, the crank-handle should be unshipped when using the electric motor. Similarly, in lowering the hoist, whether empty or full, during the employment of hand-power, it is a safe rule to unship the crank, shipping it again to make the next hoist.

134. (1) **Circuit-breakers** should be set to stand quick starting under full load, under normal conditions, but must not be blocked or lashed or held in place by the hand, as they do not then protect the electric mechanism in the circuit. Care should also be observed that they are not screwed down too much, as this would have the same effect as "blocking" or "lashing."

(2) In starting any electric motor, the controller should not be thrown to full speed in one movement, but it should be quickly run to full speed by stopping momentarily on the succession of notches on the controller. Circuit-breakers are installed for the purpose of protecting the system. If they are correctly set they will blow whenever the controller-handle is thrown all the way over suddenly; if they are so set that they fail to blow under such circumstances they no longer protect the system.

(3) When a circuit-breaker "blows," always place the controller on the "off" position before closing it. This is important, otherwise it will "blow" again and large sparks will be made at the switches in dynamo-room. Hoistmen should be drilled at this, by the turret-officer throwing out the circuit-breaker while the hoist is running, and requiring the hoistman to place the controller on the "off" position before the circuit-breaker is closed.

(4) Always throw the circuit-breakers out, when through with the drill, exercise, or work at hand.

135. Switches should be examined occasionally for good, tight connections and to see that they are kept clean and free from oil. They should be habitually left open when not in use. Accidents have occurred when cleaning brightwork around a closed switch.

136. (1) **Electric fuses.**—The fusing point of electric fuses is at double their rated capacity (which is stamped on the fuse), and they are tested to carry *steadily* an excess of 50 per cent above their rated capacity, but nevertheless when fuses are located in a hot place where they are unable to dissipate their heat sufficiently fast for rapid, continuous work, they will sometimes "blow" when the *normal* current has been on for some time. When such blowing of the fuse is due to its *hot location rather than to excessive current*, a fuse one size (but only one size) larger should be substituted. Before inserting the larger fuse the turret-officer must assure himself that the current which blew the first fuse was normal, and hence that the cause of blowing was due to the location of the fuse.

(2) The exact location of all fuses must be known by the turret-officers, turret-captain, gunner's-mates, and electrician of the turret.

(3) Spare fuses of proper capacity should always be kept in the turret, so that they can be quickly put in place.

137. (1) **The electric telescope-rammer** should usually be handled at full speed except at points of extreme extension and withdrawal. It should not be rammed out to *full extension* at full speed, nor should it be run in hard, at full speed with *current* on. The rammerman should be carefully instructed in bringing it up. In withdrawal at full speed it will come up with a bang, but the controller should be at "off" before this time, in which case the rammer will be found to withstand the shock, due to its inertia alone.

(2) **The friction-brake** should be so adjusted as just not to slip while the shell is being pushed off the car into the gun. When set on this basis the rammer can usually be run out full speed, without injury, the friction-brake slipping at full extension; but this is inadvisable, as it is a severe strain, and the rammer should be fully reversed just before full extension. If *run in* at full speed however, the returning-wire will usually break, but no other injury will be done to the rammer or mechanism.

(3) **The rammerman** must accustom himself to stopping the rammer at the proper instant (just before extreme extension or retraction) by reversing the current (throwing the controller-lever over to full speed the other way) as quickly as possible.

(4) Rammers may be started faster than hoists, but the same principles should be observed in starting, that is, throw over the controller-lever quickly on the successive notches, but not in one

single throw. Ram the shell hard, bringing it up with a bang, otherwise it will probably tumble, wobble or perhaps break up.

138. (1) Electric-turrets train with varying degrees of speed and nicety, depending on the type of electric training-gear and the condition in which training-gear is maintained. If the training is too fast for ordinary working conditions, slower speed can be attained only by a rapid "hitching" of the controller, making the series of starts practically a continuous movement.

(2) A turret should be started slowly, working up to fast speed quickly, if fast speed is desired. If the controller-handle is thrown over quickly *in starting*, the circuit-breaker will be blown. It may however be run from *fast speed to stop*, as quickly as desired. It must not be thrown from fast speed *past stop* in the other direction, as the circuit-breaker will "blow." Practice will teach the rammerman how quickly he can work up to fast speed. There is a little "knack" in it which can be acquired only by experience.

139. Controllers.—The edges of the controller-connections burn and should be immediately smoothed off with a file and emery paper. If this is not done at once they will keep on burning until the controller sticks when the handle is thrown over.

140. Testing turret-mechanism.—All turret-gear (hoists, rammer, elevating- and training-gear), should be run each morning in port. An hour, say between 8 and 9 A. M., should be set for this so that the dynamo-force will be ready and not be called on unnecessarily. The above-mentioned time is convenient as it warms up the engines for quarters, drill and Morris-tube exercise.

141. Signals to hoods and handling-rooms.—An efficient system of communication from the turret-officer's position to each hood, and to the handling-room is essential. If voice-pipes are not in place they should be rigged by the ship's force. Owing to the noise made by the gear, a bell is frequently not heard in the handling-room, hence a light placed in circuit with the bell will call attention when the bell is not heard. In addition to the voice-pipe, a simple signal, such as a colored light, or an illuminated disc, should be provided to notify the turret the instant the ammunition-car is loaded and ready for hoisting. As above explained, the use of bell-signals in turrets is objectionable on account of the probability of mistakes, and the added noise.

HYDRAULIC TURRETS.

142. (1) In turrets fitted with hydraulic training-mechanism, there is usually one hydraulic plant for each turret, and the two

plants are interchangeable between the two turrets. One plant will operate both turrets at moderate speed. The plant generally consists of two or three vertical or horizontal, differential plunger-pumps, driven by steam cylinders fitted with Dow's valve-gear, combined pressure-regulator and governor, accumulator, and water-tank. The pumps are arranged side by side and deliver into a common discharge to the central column of the turret. A 6-inch hydraulic pipe connects the pressure side of the forward and after sets of pumps, while a 6-inch galvanized pipe connects the return (exhaust) of the forward and after turrets, thus enabling the turret to be operated by either set of pumps. Each set of accumulators is fitted with an air-compressor and an air-chamber, all connected together and resting upon a common base. The accumulator insures a steady pressure. For supplying each plant with fresh water, a feed-tank of about 1000 gallons capacity is located near each pump-room. The working pressure is 600 pounds per square inch.

(2) Main pressure and main return (exhaust) valves are located in the pump-rooms.

(3) Inside the turret, each gun has its own system of valves. There is no *main-exhaust* valve inside the turret, as the main-exhaust system is controlled by the main turret-return or exhaust-valve located in the pump-room, and this valve should be *wide open* before pressure is turned on the turret. Inside the turret, the main pressure-valve of each gun-system has *general control* over the pressure to the rammer, elevator, ammunition-hoist, and recoil-cylinder; but, in addition, each of these has its own valves.

(4) Before turning pressure on any motor, see the operating-lever in *mid-position*, so that the motor will not move of its own accord. Men stationed at the operating-levers should move the motors sufficiently to satisfy themselves that they are in working order.

(5) When hydraulic pressure is first turned on a turret there may be noise and thumping throughout the system of pressure-pipes, due to air in the pipes and the velocity of the water; but no harm can be done, and the noise will soon cease. *When the pressure is first turned on, the valve must be cracked slightly and opened slowly, so that the entire system may fill gradually.*

(6) Violent fluctuations of pump-pressure should not be tolerated, as every joint on the pressure-line is endangered, and water-rams frequently bend piping out of place, particularly small piping, and so open up the joints; this is to be particularly

borne in mind in connection with turning pressure on the turrets. Certain hydraulic turrets have small priming-valves on pipes which lead from the distributing-valve casing to the valves of the training-motors, and the pressure thus supplied balances the latter. If these valves be not open the turret cannot be moved, and therefore they should always be left open.

(7) **Before unlocking any turret**, and more particularly an unbalanced one, it should be certain there is pressure on the training-motors and that the air is out of the system. Let air out of motors by means of pet-cocks on cylinders; elevate both guns several times to work all the air out. Move training-valve slightly while watching centers of training-motor shaft and the top eccentric; any motion is thus easily detected. If the turret will not move one way, try it the other and stop it the instant it starts to move. It will be necessary to start the locks out a turn or so to do this, if they are set up hard. In putting in locks, the head of the motor-shaft is of service to the trainer in detecting a slight movement of the turret in train.

143. Communication with pump-room.—The question of turning pressure on and off a hydraulic turret is so important that the ordinary system of communication with handling-room or a system of bell-signals should not be trusted. Pressure should be turned on or off a hydraulic turret only by order of the turret-officer or turret-captain direct to the petty-officer in charge of the pumps or by written order of the turret-officer to the engineer of the watch, otherwise pressure may be turned on a turret when not wanted or turned off when most desired. Any system of signals less positive than this is unsafe, and trouble has occurred by trusting such orders to voice-pipes.

144. Exhaust-valves.—As a rule, the various exhaust-valves of hydraulic systems should be kept *open at all times*. In opening valves, always see the exhaust-valve wide open before turning on the pressure; and in closing always close the pressure-valve first. The valves should be opened and closed slowly. The static pressure is greatly increased by the "water ram," caused by closing valves rapidly and suddenly stopping the flow. After opening wide, ease the valve back a turn; and after closing tight, ease the valve slightly off its seat,—this will prevent the valve jamming or sticking.

145. (1) Exhaust-valves open.—Leave the exhaust-valves of hydraulic ammunition-hoists open at all times. If upon opening or closing the pressure-valve, the car starts up of its own accord and refuses to answer the operating-lever, you will know that

the exhaust-valve has been *closed*. Open the exhaust at once, and then the car will be under control.

(2) Should the hydraulic ammunition-hoist fail to work when full pressure is on the motor, it is an indication that the piston-valve is leaky and the surfaces must have become worn or scored. Take out and overhaul the piston-valve; if necessary it should be turned down, a new surface shrunk on and ground in.

146. (1) **Elevating mechanism.**—The pressure- and exhaust-valves of the elevating-motor are controlled by a lever on the platform of the central hood. When the main pressure-valve is open, the breech of the gun can be raised by raising the lever above the horizontal position, which admits pressure to the bottom of the elevating-cylinder. To lower the breech, push the lever down below the horizontal position, which opens the exhaust of the elevating-cylinder, when the weight of the gun will force the water out of the cylinder through the exhaust-pipe. The breech of the gun moves up and down with the lever; and the speed depends upon the throw of the lever which regulates the amount of valve opening. The same pipe acts as pressure and exhaust between the bottom of the elevating-cylinder and the valve-chest, depending upon which valve is opened by the double-throw lever.

(2) When the elevating-lever is in a horizontal position, the gun remains at rest,—both valves being closed.

(3) When raising the breech above the level position, water should be admitted very slowly to the elevating-cylinder in order that the piston may not strike the ring in the cylinder, and also that the cylinder may not overflow.

(4) **The elevating-cylinder** being open at the top, the men should be cautioned not to let tools or other articles, or dirt of any kind, drop into the cylinder, as scoring of the cylinder or ram would result. When any overhauling is being done and there is a likelihood of anything dropping into the elevating-cylinder, the cylinder should be covered with canvas or other suitable material, and generally when any piping is taken down or valve removed the exposed parts should be carefully covered. The interior of the cylinder should be examined weekly for rust above the ram or piston.

(5) In lowering the gun to the loading-position, or to any other position on the rest-lugs, it should be brought to rest gently.

(6) When the gun is being loaded, the exhaust-valve should be kept slightly open.

(7) The rest-lugs mark the loading-position (elevation of 10°) and the gun should not be fired when resting on them. Sometimes the rods operating the rest-lugs are sprung by being thrown down with too much force, and the gun-slide catches on the upper edge of the lug and will not descend to the loading-position. Raise the gun off the lugs and spring them close in against the platform-girder.

147. (1) **Training-mechanism.**—The pressure for the training-motors comes direct from the pumps to the motors, and therefore the turret can be turned without admitting pressure to the pipes of the gun-systems. The training-motors are operated by moving the lever or wheel of the control-gear; but in turrets fitted with automatic follow-up gear, the port-opening of the control-valve will be gradually closed and the turret will come to rest, unless the control-lever or wheel is kept in continuous operation.

(2) The speed of the turret depends upon the port-opening of the control-valve up to the full power of the pumps. The full power of the pumps must not be approached however, as the consequent heavy water-hammers in the piping are apt to wreck the whole system, and it is therefore very convenient to have a pointer and graduated arc, located on the central platform, which will indicate at all times the *position* (port-openings) of the control-valve.

(3) The control- and follow-up gear should be inspected frequently.

(4) Do not unlock the turret until the pressure is on both training-motors, and until the pressure is steady; *this rule should be strictly followed, especially at sea.* If thumping commences in the cylinders of the training-motors, open the relief-cocks for a few minutes and let the air escape.

(5) When the ship is rolling or when working very slowly, the training-motors are likely to make a shrieking noise on account of doing unequal work; but this will do no harm. The motors should be kept clean and well oiled, or the connecting-rods will heat and cause trouble.

(6) Before turning, fill the oil-cups with a mixture of Albany-grease and oil, screw down on the piston of the oil-cups and force the mixture into the oil-ways, then refill the cups. Fill the oil-pans, and oil the connecting-rod bearings; the latter are of soft metal and must be kept well oiled to prevent heating.

(7) If the bearings do not heat and the cylinders are clean and tight, you need not worry about occasional groaning or

shrieking of the motors. When turning the turrets in a seaway, should the pressure suddenly fail and the turret not be in position for locking, immediately put the training-valve in mid-position. In case the pumps cannot be started, get hawsers around the guns, just outside the ports, and set taut on them.

148. (1) When operating the hydraulic rammer, turn on full pressure at once if ramming a shell. When the rammer-head strikes the shell it telescopes back into the larger section without shock, and starts the shell forward rapidly. This prevents the shell from sticking on the compression slope.

(2) It is useless to attempt to force the shell home by more than one blow of the rammer; if the shell sticks in the slope of the chamber, to withdraw the rammer and force it in the gun again will do no good, but will endanger the hydraulic fittings by causing a water-hammer.

(3) During action, if the shell sticks when nearly home, fire it with a reduced charge; at other times, loosen it with a pinch-bar and withdraw it with the extractor, or drive it to the rear with a strong-back.

(4) With most rammers, when the operating-lever is in mid-position, the rammer will withdraw slowly; this prevents the rammer extending on account of slight leaks.

(5) If the rammer, whether hydraulic or hydro-pneumatic, is run out with full force when not ramming a shell, it is almost certain to be disabled.

149. (1) Gun-working mechanism.—The gun-working valve (located near the main-pressure valve), admits pressure to the rear end of the recoil-cylinder through the automatic check-valve. (Indiana class.)

(2) The gun-valve may be used to control the speed of counter-recoil. When firing in smooth water, if the gun is properly handled it will be quickly dropped after each round and the gun returning to battery must climb an incline. In such cases the valve may be left wide open so that the gun will return quickly to battery.

(3) The valve should operate easily so that a hand stationed by it may close it a few turns if necessary on the return, so as not to allow too heavy a blow to be struck on the counter-recoil buffer-lugs.

(4) When firing in a seaway, the valve should not be left so wide open, for the gun might go back to battery with great violence on a downward roll.

(5) When the gun is run out and in position for firing, the

piston-rod is drawn out of the recoil-cylinder its full length and the cylinder is full of water.

(6) **The pumps** should be in operation and the recoil-cylinder and system filled before the gun can be fired. The pumps should not be stopped during the firing. Water is admitted to the recoil-cylinder only at the rear end through the automatic check-valve, which is kept open by the pressure. At the forward end of the recoil-cylinder are three spring relief-valves opening into the overflow-chamber. As the recoil-cylinder is rifled, the pump pressure is exerted on both sides of the piston, and the spring-valves should be set up to resist 600 pounds pressure, in order to prevent the escape of the water; but when the pressure is exceeded, the valves lift and allow the water to escape into the overflow-chamber, and thence through the flexible hose and exhaust system back to the feed-tank.

(7) **When the gun is fired**, the pressure inside the recoil-cylinder at the rear end, being much greater than 600 pounds per square inch, the automatic check-valve closes and seals the rear end of the cylinder, the piston-rod is driven into the cylinder and, as water is incompressible, the amount it displaces escapes through the spring relief-valves into the overflow-chamber, whence it is carried by the flexible hose to the exhaust-system. The recoil is checked by the limited flow of the water through the grooves of the cylinder, and while the spring-valves are on the reverse side of the piston, the tension on the springs does somewhat affect the recoil, and if they are set up too much the length of the recoil will be reduced. These valves should be tight at 600 pounds pressure and should have a lift of about an inch to allow for proper valve-openings for the escape of water when the gun is fired. As soon as the recoil is checked, the 600 pounds pressure of the system forces the check-valve open, and acting on the piston returns the gun to battery-position, the area of the piston-rod serving as the ram.

(8) If the relief-valves are adjusted for less than 600 pounds pressure, some of the water passing through the grooves at this pressure would escape through the lifting relief-valves, and the gun would be slow in returning to battery-position.

(9) If the relief-valves are wide open, the water will simply circulate through the system and the gun will remain at rest in the "run-in" position. The gun is "run-in" and "run-out" ordinarily by the central relief-valve; the two side spring-valves should seldom be touched after they are adjusted.

(10) In the springs provided for relief-valves there is always

enough play to permit of the full opening of the valve. The lift should be at least one-fourth of the diameter of the valve-opening, and whenever the relief-springs are set up, the officer of the turret should assure himself that the total distance *between convolutions* is greater than this,—usually about one inch.

(11) It is better to have leaky valves than to have them set up too hard. Upon finding that the valve is leaking, the first tendency is to set up on the spring; but as the springs rarely get any permanent set after once being set up, the proceeding is dangerous.

(12) A complete, spare set of relief-valves and valve-seats should be carried in stock; these should be in order, and just before any firing is expected to be done or after considerable has been done, the valves and seats which have been in place should be removed and the spare ones put in. The importance of this will be readily seen when it is remembered how violently these valves are forced on and off their seats.

(13) If it is impracticable to have spare valves and seats, ordinary treatment will suffice. Generally a cut will have to be taken off the valves, and the valve reseated; this latter may of course be done with the seat in place. When the valve is taken out for grinding in, the stem should be tested for straightness. Relief-valve springs, as well as all others in the turret, such as buffer-springs, should not be painted, but oiled.

150. (1) To "run-out" the gun on an hydraulic mount, set up a few turns on the central relief-valve, turn on the gun-pressure and then continue setting up slowly on the central valve until the gun runs out.

(2) Before firing, be careful to see that the wooden holding-out chocks have been removed.

(3) To "run-in" the gun on an hydraulic mount, lower the breech until gun is at extreme elevation, and then ease off slowly on the central relief-valve and let the water escape from the recoil-cylinder, and the gun will run in gently. The slides must be kept well oiled. If the gun does not start at once, do not let too much water escape by keeping the spring relief-valve lifted, otherwise when the gun does start it will come with a rush.

(4) In running in guns with their central relief-valves, have elevating-gear manned and catch the gun with it in case it starts to take charge. The gun must not be left run out at extreme elevation, or in loading position, with pressure off the turret even if holding-out chocks are used.

(5) When the hydraulic pump is used to run-in a gun on

spring-return mount, it must be used only in the presence of and under direction of the turret-officer. The pressure should never be allowed to exceed 2500 pounds. Unless care is taken to follow this rule, and should this pressure be exceeded when the gun is all the way in and the springs compressed solid, it is possible to burst the recoil-cylinder.

(6) The speed of recoil and the speed of counter-recoil can to a great extent be controlled by the pressure-valve to the recoil-cylinder.

151. (1) Relief-valves.—After a gun on an hydraulic mount is run out, the relief-valves should be carefully adjusted, and they should be *tight* under a *steady pressure of 600 pounds*. To ascertain if they are properly adjusted, take off the bonnet of the overflow-chamber, and see if *easing off slightly* on the valves causes a fine spray around the valve-seat; if so, they are properly adjusted. After this adjustment, use only the central valve; and by remembering the number of exposed threads on the valve-stem, you can approximate its proper adjustment for future occasions.

(2) When a pressure of 600 pounds, or less, is turned on the recoil-cylinder, and it is found that the carefully-adjusted relief-valves are leaking badly and water pours from the overflow-chamber through the air-valves, you will know that the main-return (exhaust) valve from the turret has not been opened in the pump-room. Have it opened at once, before damage is done. Fresh water will be lost by the air- and relief-valves relieving the excessive pressure, and probably the flexible rubber-hose will burst. It is of vital importance that the main relieving-valve (exhaust) of the turret should be *opened wide* by the pump-force before they turn pressure on the turret. The relief-valves serve as a safety-device for the recoil-cylinder; they relieve excessive pump-pressures, and they relieve the great pressure of recoil by allowing the water that is displaced by the piston-rod to escape.

(3) Should the spring relief-valves leak considerably, no ill-effect would result from firing, because the pumps would keep the recoil-cylinder filled, and the leakage would be carried off by the flexible hose; but the gun might be slow in returning to battery. Relief-valve springs are always tested before firing.

(4) A good way to go about adjusting the relief-valves preparatory to firing and after the valves have been carefully ground in, is to see that all pressure-gauges are in order, or at least one that is in order must be used. The governors of the pumps must

also be in order, so as to trip at a few pounds above the pressure allowed. Suppose the working-pressure is 600 pounds, the governors ought to control this between 600-625 pounds. Set up relief-valves to about what they ought to be and turn pressure on the turret; remove small, hand-hole plate from overflow-chamber; slack off or set up on each valve until each shows an equal leak, which must be a very fine "fantail" coming from all parts on the circumference of the valve. Set each valve up an equal amount until the leak just stops; increase load on pump-governors about 25 pounds, when the valves will probably all begin leaking again. If not, each must be slacked off until it does leak as before the pressure was increased. Then work valves just before firing so as to be sure they have not been moved. Observe if there is still plenty of total space between the convolutions of the relief-valve springs to permit the valves to lift a proper amount. Replace hand-hole plate on overflow-chamber and resume standard pressure. After this there need be no fear of bursting the exhaust-hose and the recoil is sure to be checked in a most satisfactory manner.

152. (1) The small air-valves on top of the overflow-chamber should be kept clean and in good working order; otherwise they will fail to open, the overflow-chamber will remain full of water, and when the gun is fired the flexible rubber-hose or the overflow-chamber itself will burst.

(2) When the gun is about to be fired, it is desirable not to have any unnecessary flow from any of the motors to exhaust, as this will increase the pressure in the flexible hose, and to save this hose the central relief-valves should be set about twenty-five pounds above the governor-pressure of the pumps.

153. (1) With a handling-room truck operated by a hydraulic motor, care should be taken that the operating-lever is thrown to the position for shutting off pressure as soon as the car is locked to the base of the ammunition-hoist; otherwise, if the turret is turned and pushes the handling-room truck in the direction *against the pressure* of its motor, the ammunition-hoist guides and base are liable to be twisted out of shape. The best plan would be perhaps to dismount the hydraulic motor and remove it altogether from the handling-room. It is dangerous and almost worthless. The car may be easily fitted for being operated by hand, and a brake can be devised for controlling the loaded car in a seaway. If there are no means for locking the truck to the car in order to remove the shell from the ammunition-hoist (a thing essential at drill), it should at once be provided.

(2) In the earlier marks of turret-mounts, when both ammunition-hoists are fully loaded and supported in their rests, and whether or not the handling-room truck is also loaded and locked to moving parts, it is highly undesirable to start to train the turret at a high rate of speed for more than a very few degrees of train. If, for example, with the conditions as described, the turret were very rapidly trained through 90 degrees of arc, the ammunition-hoist guide-rails would be apt to be badly twisted and so jam the hoist; this is most likely to happen on first casting loose the turret. The handling-room crew should help the handling-room truck around when it is evidently bringing a considerable twisting stress on the ammunition-hoist guide-rails.

(3) Before beginning to ram the shell into the cylinder, the handling-room car should be securely locked to the base of the ammunition-hoist, so that the car will turn with the turret.

154. (1) The flanges of hydraulic-pressure pipes should be painted *black*, and flanges of exhaust or return pipes *red*, except that the flanges of the main water-collar should not be painted at all. It is a good plan to have as much of the piping as practicable kept bright. It adds to the appearance of the turret; the reflection of light from piping assists in detecting leaks, and the bright copper piping appeals to the crew as being vastly more delicate than painted pipe, hence it causes them to handle it with greater care.

(2) All hydraulic turrets should have a set of clamps for covering cuts in hydraulic piping. The hydraulic elevator-buffer, or "dash-pot," should be kept filled with liquid and its stuffing-box kept tight. The weight of the gun rests on knife-edge bearings of smaller trunnions, which are supported by hardened plates dovetailed into spring- or elastic-bars. The height of the spring- or elastic-bar is adjustable by heavy screw-bolts. The bars should be approximately parallel to the deck, and the adjusting screws should be set up just enough to admit of slipping a piece of thin writing paper *under the trunnion*, being careful at the same time to have an equal amount of play between the trunnion and trunnion-cap. When the gun is fired, the elasticity of the spring-bars allows the weight to come on the trunnion-seats. The knife-edges and spring-bars should be kept clean, but not polished.

155. (1) When secured for sea, turret-guns on hydraulic-mounts are "run-in" and at extreme elevation. Even in smooth water and when entering port, except when there is a possibility of using the guns, they should, if mounted in unbalanced turrets, be kept run-in, otherwise they may change the deviation of the

compass. On some ships it has been found necessary to wedge the guns on their slides to prevent excessive vibration and its consequent ill-effect on the mount. This is more marked in after-turrets.

(2) Turret-guns mounted on spring-return mounts are secured for sea "run-out."

156. (1) Care of mechanism.—All working mechanism of a turret gets stiff if not moved frequently, and when started will require an unusual amount of power; hence, turn turrets, work all the motors and move all the valves daily, if practicable. It keeps their cup-leather packings soft and pliable, stops leakage, and prevents valves from "freezing." (One exception to moving valves might well be made, however—the exhaust-valves of the ammunition-hoists should be moved only rarely and then left open.)

(2) On some ships, especially the earlier monitors and battleships whose turrets are unbalanced, it may be undesirable, at certain periods of the year, to turn the turrets every day, especially if awnings are spread. At such times on these ships it will be quite sufficient to move the turret a few degrees each way and operate all motors and valves daily, provided of course that the turret is frequently and regularly cast loose for general quarters and Morris-tube practice.

(3) If such ships be rolling a great deal either in port or at sea, it will be best not to unlock the turret, except occasionally as a matter of training the crew, but turn on the pressure and operate such valves and motors as may be possible.

(4) It is quite important to be careful to oil the lower bearings of the hydraulic training-engines; their oil-holes are near the platform and are comparatively inaccessible; on some ships in commission they have been known to go without oil for months, to their serious injury.

(5) The hydraulic motors have cup-leather piston-packings and balanced piston-valves; the cylinders and valves should be occasionally cleaned and the packing oiled.

(6) The whole matter of overhauling and renewing cup-leathers is difficult to decide. Some leathers—notably those of the main water-collar and of the training-motors—rarely need renewal. It is evident that if a leather in place is perfectly good it is better to leave it in place than to renew it, but the leathers are hidden from view and frequently give no warning of weakness until they give way and have to be renewed at once. Such an accident might disable a gun or even a turret at a critical time.

(7) The water-collar cup-leather in the gun-motor line is the most likely to give away in most mounts.

(8) When a rammer is working well and all its cup-leathers are tight, it should as a rule be left undisturbed,—unless it is not likely to be used for some time and there are plenty of good leathers on hand and a thoroughly competent person to put them in.

(9) As a rule, it may be stated that the proper way to treat cup-leathers is to keep a record of their length of service and renew them after one year. All cup-leathers in store should be in castor-oil.

(10) If the rammer-packings become dry, the water will, upon admission of pressure, spurt from the ends of the sections, and the rammer may not function until the cup-leathers become soft and tight. In case such a leakage occurs, continue to run the rammer out and in until the packing has softened sufficiently to act and stop the leaks.

(11) As the rammer is the most delicate machine in any turret, it should be carefully nursed and operated every day except when impossible on account of repairs. It is not necessary or desirable to work the rammer its full throw, except to ram a shell or occasionally to test it throughout its whole travel. The rammer should not be allowed to remain fully extended for any considerable length of time, as it is then sure to sag and thus impair its efficiency.

(12) A good way to treat a hydraulic or hydro-pneumatic rammer is to shove the head up against the gun or mount, turn on pressure and leave it on for an hour or so. The joints of the pressure-piping of the rammers should be most carefully made as they have to stand some rude shocks.

(13) When the guns are resting on the loading-pawls in the level position, the elevator-cylinders should be kept filled and the pistons held up against their rods; this keeps their leathers in good order and also helps to support the gun, which assistance would be the more valuable in case the pawls were to carry away.

157. (1) **Packing.**—Four kinds of packing are used in hydraulic-turret mounts. Cup-leather packing and ordinary stuffing-box packing are used when a tight joint must be kept between two sliding parts. Leather discs are used for the joints of pressure-pipes; and rubber packing is used for joints of exhaust-pipes.

(2) A cut across a cup-leather packing or a bad scratch will render it useless. The edges of the cup-leather are shaved down thin, and it is arranged so that the pressure comes on the hollow

side, so that the greater the pressure the more tightly will the packing act.

158. (1) Slight leaks in the glands of hydraulic cylinders, can, as a rule, be corrected by "setting up" and by "soaking," unless the packing is worn out or the cup-leathers are perforated.

(2) In setting up glands to stop leaks, too great a force should be avoided, as it can be carried to such an extent as to jam the rod. It is better to have a slight leak than to set up too tightly; but the proper remedy is to repack the gland, if a reasonable setting up does not prove effective.

(3) Bad packing and perforated or badly cut cup-leathers *cannot be made tight*. Renew them at once. New packing and new cup-leathers should make tight joints after the first thorough soaking; if they leak, it shows that the gland has been improperly packed or the cup-leather has been badly cut or cut with the wrong bevel. Replace packing or cup-leathers which leak much after the first wetting, for they will never be tight and will be the source of constant annoyance.

159. (1) **Valves and valve-seats** should be kept thoroughly clean. Grit and other foreign matter may frequently be removed from the face of valves by allowing the water to flow through by opening both pressure- and exhaust-valves.

(2) The life and efficiency of every hydraulic system is directly dependent upon the condition of the valve-faces and valve-seats, and an officer charged with the care of a hydraulic turret should, from a personal inspection, be familiar with the condition of the valve-seats and valve-faces.

(3) The action (on metal) of water, moving with great velocity, under pressure, is somewhat similar to the erosion produced by the flow of gases under pressure. It will seek weak or rough spots, or scores, in the faces of valve-seats and valves and will cut out and enlarge the places at a constantly increasing rate. All valves and seats should be clean, smooth, and symmetrical, and in circular valves, should not be allowed to wear oval in shape. When the cutting is first noticed, the valve may usually be ground-in in place, but when the seat or the valve has become rough, uneven, streaked or ragged, the valve, if circular, must be put in the lathe and turned down to good metal, while the seat must be cut anew with a valve reseating-machine.

(4) A simple test for the tightness of a valve is to close it and apply the ear to it. If there is no leak, there should be perfect silence within the valve. A small leak will be indicated by a slight hissing sound, the size of the leak varying directly with the

intensity of the sound. Flat valve-surfaces must be scraped by hand and tested on a surface-plate.

160. (1) **The fresh-water supply-tank** should be kept clean and the whole hydraulic system of the turret washed out occasionally. It is a good plan to put either glycerine or soft-soap in the fresh-water supply-tank, preferably glycerine. Distilled water only should be used in the tanks, and its temperature should be kept as low as possible. All cylinders, pipes, and valves should be kept drained, *especially during freezing weather.*

(2) The engineers must be careful to overhaul their hydraulic pumps frequently, and if hard-rubber valves are used, they must be renewed before there is any possibility of their breaking up and the fragments being carried throughout the system.

DRILLS FOR MAIN-BATTERY GUNS.

NOTE.—Throughout the detail-drills the notes are frequently referred to by giving in brackets the number of the article and paragraph to which it is desired to refer.

TURRET-GUN DRILLS.

Notes.

161. (1) The following detail drills include the drill of typical turret-mounts in the U. S. Navy. The drills relate to individual turret-guns rather than to the drill of the turret as a whole.

(2) When both guns are being fired, the turret-officer will retain perfect command of his turret by prefacing all orders, and requiring all reports to be prefaced, by the command *Right* (or *Left*) *gun*. The most effective method of firing the guns of each turret (that is, the sequence of firing them) is a question of great importance which must be carefully considered by each turret-officer. The following drills *suggest* methods which may be advantageously followed, but officers are expected to exercise their ingenuity in devising the method most applicable to their particular turrets.

(3) Station of turret-officer.—Though turret-officers are encouraged to carry out daily Morris-tube training along with their pointers, this is chiefly for the purpose of better fitting them to train their crews. If the turret-officer has so trained, he is competent to fill the position of a pointer in case of necessity, but his proper station in action or at target-practice is in the rear of his turret, where he can exercise command over every operation, control the fire, and communicate with the conning-tower, the pointers and the handling-room. His duties are therefore of such importance to successful gun-fire that it is especially forbidden for him to act as pointer in action, *except in case of absolute necessity*.

(4) Station of junior-officers of turret.—In action the junior-officer of a turret will generally be stationed in charge of the ammunition-crew, though he may at any time be called upon to assist the turret-officer in case of accidents in the turret or elsewhere. As the junior-officer may in action be called upon at any moment to assume command of the turret, he should be thor-

oughly familiar with all of the duties of a turret-officer; and the latter will see that his junior is afforded sufficient opportunity to acquire this necessary familiarity with his duties.

(5) **Station of turret-captains.**—The turret-captain, next to the turret-officers, has charge in the turret. He should go where, in the opinion of the turret-officer, he will be of the greatest service in promoting the efficiency of the turret as a whole. Generally speaking, he should be held in readiness to go to any point where his special knowledge will be of value in remedying defects, etc., and he should be prepared at all times to take charge of the turret in case of the death or absence of the turret-officers. At *Cast Loose and Provide*, when both the turret-officer and turret-captain are present, he will exercise general supervision outside, and see everything clear, then go to his station in the turret.

(6) **Commands.—**

(a) Except in cases of emergency, no commands other than those specified in the following drills should be given by any one in a turret. The drill should be conducted in perfect silence, each man performing his own duty and, when necessary, simply making signs to the other members of the crew. The turret-officer alone will give any necessary commands, and these will usually be directions only to the gun-pointers and sight-setters, in regard to pointing, and to the crews in regard to the sequence of their duties in loading, etc.

(b) If at any time any member of the turret-crew discovers anything radically wrong, such as to necessitate immediate stoppage of the movements, he will call out **SILENCE!** in a loud tone of voice, whereupon each man will instantly stop what he is doing, stand in his tracks, and wait until the turret-officer ascertains the trouble and directs the remedy. Drill will be resumed at the command **CARRY ON!**

(7) **Drills not mandatory.—**

(a) The drills herein laid down are, in each case, *actual drills with which excellent results have been accomplished*; but, except in regard to safety precautions, they are *in no sense mandatory*, and officers are encouraged to exercise their ingenuity to improve them in every way which may produce more hits per minute. For the sake of uniformity, it is of course desirable that no changes be made, *except with this object in view*.

(b) *In drilling a turret-crew*, the members of the crew should first be thoroughly drilled in their individual duties, devoting particular attention to the *details* of each individual movement. Then as a whole, devoting particular attention to the sequence in which these duties are performed, and gradually work the crew up to speed by the use of stop-watch to time *each man* in the performance of his duty. The use of a stop-watch, at every drill, is a material aid in developing rapidity of movement.

(8) **The locks** should be kept in place on the guns, and fully screwed on, whenever there is a likelihood of the guns being used.

(9) *Steadiness, regularity, and silence* in the performance of duty should be exacted of every man in a turret-crew.

DRILL FOR 12-INCH OR 13-INCH TURRETS. MAINE, FLORIDA, AND ALABAMA CLASSES.

12-inch of Maine class and Florida class (Mark III guns on Mark IV mounts).

13-inch of Alabama class (Mark II guns on Mark IV mounts).

NOTE.—Attention is especially invited to Notes on Turret Mounts, Arts. 113 to 142.

STATIONS.

[14*]

162. (1) Turret-officers and turret-captain in the most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) The gun-pointer group consists of two men for each gun-pointer-station and two men for each training-station; called 1st- and 2d-pointers and 1st- and 2d-trainers. The 1st- and 2d-pointers alternate at pointing and sight-setting, and the 1st- and 2d-trainers alternate at training and sight-setting [28, 54, 56, 57, 93, 94, 95].

(3)

Gun-crew.

Title.

Station.

Plugman.	Plug-crank.
1st-loader.	Rear and outboard of breech.
Rammerman.	Rammer-controller.
Hoistman.	Hoist-controller.
2d-loader.	Rear and inboard of breech.
Messenger.	Communications.
Gunner's-mate.	Wherever needed.

Notes.

163. (1) One member of each gun-crew shall be detailed as gun-captain and shall be stationed with special reference to his overseeing the working of the crew (Part I, Art. 64).

(2) The plugman and 1st-loader must be large, strong, active men. The other members of the crew must be intelligent, careful men; great strength not required [116, (7)].

*NOTE.—This refers to Article 14, Part II. Similar references throughout the drills refer to articles (and in some cases to the paragraph, or paragraphs) in Part II, to which it is desired to invite attention.

(3) Two gunner's-mates must be detailed for the care of the guns and turret, and one gunner's-mate for the care of the handling-room, shell-rooms and magazines. To assist in the care of the guns and turret, one man should be detailed from each gun-crew [116, (1), (4), (5), (6)].

(4) One electrician must be detailed to care for the electrical appliances in the turret, and he should always be present in the turret at general quarters. This electrician remains in the powder-division, but is stationed in the turret at drills, and will have general charge of all electrical appliances therein.

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the turret-officer, if necessary.)

164. (1) **CAST LOOSE AND PROVIDE! LOAD!** (designating object, direction, range, and also the setting of the sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

NOTE.—Very few commands should be necessary. The firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as much as possible, without commands.

Stations!

(2) At this command, which may be given at any time, each member of the crew will take his proper station at the gun, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained and all operations cease. The men stand in their tracks and await orders.

Cast Loose and Provide!

[20 to 32]

(Guns secured for sea or port.)

165. (1) **If the port-bucklers are shipped,** the members of the crew remove them before performing their other duties, the plugman, 1st-loader and messenger working inside, the rammer-man, hoistman, and 2d-loader working outside. The turret-apron or water-shed will be raised clear of the barbette and the turn-buckles and wedges removed by the 2d-pointers and 2d-trainers

[122]. As soon as the port-bucklers and tompion are removed, the gun-pointers will lay the guns in the loading position.

(2) **The turret-officer or turret-captain** assures himself that everything is clear outside of the turret before allowing it to be trained.

(3) **The 1st-pointer and 1st-trainer** take the plugs out of the peep-holes in the sighting-hoods; take caps off of telescopes; inspect sights and sight-mounts; connect electric firing-wires to batteries and ground-terminals [96], and test firing-circuits [21]; turn on sight-lights; test elevating and training-controllers; close elevating and training-switches and circuit-breakers; test elevating- and training-gear to make sure that everything is in working order; lay the guns for the removal of the tompions, and then put the guns in the loading-position; report anything out of order to the turret-officer; take their stations in the pointing- and training-hoods, set sights, and train as directed.

(4) **The gun-captain** reports to turret-officer when his gun is cast loose and ready in all respects for loading.

(5) **Plugman** opens the breech and inspects the gas-check [108, (10)] and breech-mechanism [27; 29; 51, (9)]; sees that the electric firing-wires are properly and securely connected to the breech-terminal, plug-terminal and lock-terminal; inspects the lock and tries it, to make sure that it is in working order [97]; sees priming-wire, boring-bit and vent-cleaner in place and ready for use [26]; provides himself with a hand primer-extractor; takes station at plug-crank, facing to the rear; reports anything not in working order to the gun-captain [114].

(6) **1st-loader** provides loading-tray [39] and places it convenient for use; sees bristle- and marine-sponges ready for use [26, (2); 31, (4)]; sees lock-lanyard ready for use [26]; examines the bore, making sure that it is clear of obstructions, and reports "Bore clear" [32]; examines gas-check seat to see that it is clean and is not scored; provides himself with primers [21, (2)]; takes station outboard of and to rear of breech; reports anything not in working order to the gun-captain.

(7) **Rammerman** unlocks turret as soon as current is on the training-motor; tries rammer-controller; closes rammer-switch and circuit-breaker [134, 135]; sees that current is on and tests rammer; sees that friction-nuts are set at correct marks [137]; takes station at rammer-controller; reports anything not in working order to the gun-captain.

(8) **Hoistman** removes muzzle-bag and tompion and reports same to gun-captain [22]; tests hoist-controller; closes hoist-

switch and circuit-breaker; sees that current is on, and tests hoist, after warning handling-room [113, (8)]; takes station at hoist-controller; reports anything not in working order to the gun-captain.

(9) **2d-loader** fills gun-tub with fresh water [31, (7, c)]; provides bucket of fresh water [48, (2)] for marine-sponge; sees loader's-platform in working order; takes station in rear and inboard of breech; sees air-blast in working order.

(10) **Messenger** takes station at the telephones, voice-pipes and battle-order indicators; repeats to the turret-officer all messages received.

(11) **The electrician** turns on turret-lights, if necessary; examines circuits, fuses, switches, and circuit-breakers; sees circuit-breaker spring set at proper tension; tests smoke-fans; provides himself with spare fuses for all circuits, and necessary spare parts and tools for making repairs to electric apparatus [134, 135, 136].

(12) **The gunner's-mate** notifies dynamo-room to turn current on turret, closes training-motor switches. Takes station near turret-officer ready to assist in overcoming any difficulties. He will keep in the turret ready for use, in racks or in a locker, the articles enumerated under Notes, Art 109.

Load!

[(32 to 40), 47, 48, 49, 51]

(The gun having been fired.)

166. (1) **1st-pointer** lays gun in loading position, the **2d-pointer** warning him to do so.

(2) **2d-pointer** sets sight as directed.

(3) **The plugman** opens the breech while the gun is being brought to the loading position (see note below, on precautions to be taken when firing both guns); extracts fired primer (in case it has not been done); examines electric firing-connections, lock, and gas-check [108, (10)]; clears vent, if necessary [30; 51, (19)]; wipes off mushroom with marine-sponge [48]; feels of mushroom-head and, if hot, reports to turret-officer.

(4) **2d-loader** lowers loader's-platform as soon as gun is fired, opens air-blast when plug is unlocked, closing it when bore is clear [107].

NOTE.—When firing both guns with present powder, which leaves a combustible gaseous residue in the breech, the gun fired must not be opened if powder is exposed in the operation of loading the other gun, unless a thoroughly tested and officially approved appliance for clearing the bore of gases is used. (See Art. 4.)

(5) **1st-loader** extracts fired primer while breech is being opened; enters the loading-tray as soon as possible [39, 40]; examines chamber and bore; reports when bore is clear [32; 51, (10)]; raises loader's-platform.

NOTE.—The 1st-loader or 2d-loader handles platform as may be found most convenient. In some of the 12-inch turrets of Maine class and Florida class it will be found advantageous to have 2d-loader handle the loading-tray, examine and report on the chamber and bore, and have 1st-loader handle the air-hose or air-blast (when fitted).

(6) **Hoistman**.—As soon as the car is loaded and bore of gun is clear, hoists the car, and when platform is clear brings car to loading position (see Dept. Special Order No. 44, of October 31, 1903) [4, (1); 113, (8)].

(7) 1st-loader shoves up shell-latch, if used, as car comes to loading-position.

(8) **Rammerman** rams shell home, withdraws rammer [33; 118, (1)].

(9) 1st-loader removes powder-batten, if used, and assisted by hoistman, keeps powder clear of rammer [2, (7); 123].

(10) **2d-loader** pulls the handle of powder-catch and allows first two sections of powder to fall into the shell-trough, in front of rammer. Plugman and hoistman rolling powder into trough and seeing it fair for loading.

(11) **Rammerman** rams first two sections of charge almost against base of shell, withdraws rammer [34, 123]. With 13-inch of Alabama type, the first two sections are rammed just inside gas-check seat, then the other two are rammed in, thus ramming the first two home [2, (6); 34].

(12) **2d-loader** works the powder dump-wheel and allows last two sections to fall into the shell-trough in front of rammer, plugman and hoistman assisting as before.

(13) **Rammerman** rams last two sections of charge until the rear end is just clear of the loading-tray, withdraws rammer [51, (11)].

(14) 1st-loader replaces powder-batten (if used).

(15) **Hoistman** raises car until weight is taken off the loading-hook.

(16) **2d-loader** holds back loading-hook.

NOTE.—Some officers do not use loading-hook, but hold car in place by hoist-brake.

(17) **Hoistman** lowers car to handling-room, as soon as car is clear.

(18) **2d-loader** drops the loader's-platform. (See note, under

par. 5 of this article, relative to loading-platform and loading-tray.)

(19) **1st-loader** sees rear end of charge in proper position to take against the face of mushroom-head, with ignition-charge in front of vent [51, (11)]. Removes loading-tray; if necessary, wipes out gas-check seat, and screw-box, with marine-sponge [48]. (See note under par. 5 of this article.)

(20) **Plugman** closes the breech, stopping just before electric connection is made, to allow the 1st-loader to insert primer [37, 61].

(21) **1st-loader** stands ready with the primer [21, (2); 51, (16)], and when breech-plug is closed within about $\frac{1}{4}$ of an inch of contact, signals to plugman to stop [61], inserts primer [105, (3)], closes lock, stands clear, and signals to plugman. (See Dept. Special Order No. 28, of August 28, 1902.) [2, (1)].

NOTE.—If percussion firing-mechanism [53] is to be used the plugman closes the breech entirely.

1st-loader, when breech is closed, inserts primer, hooks lock-lanyard, cocks lock, stands clear [2, (2), (3)].

(22) **1st- and 2d-loaders** raise loader's-platform.

(23) **When the gun is ready to be fired**, and every one is clear of the recoil, plugman fully closes the breech and taps the pointer on the leg with his hand, as a signal that the gun is ready to be fired.

Commence Firing!

[52 to 60]

167 (1) **The pointer** points and fires the gun, aiming as directed [38, 57].

(2) **The trainer** keeps the turret trained as directed [38, 57].

(3) **The pointer not pointing** sets the pointer's-sight as directed.

(4) **The trainer not training** sets the trainer's-sight as directed.

(5) **The 1st- and 2d-pointers** and 1st- and 2d-trainers stand by to relieve each other.

(6) The loading and firing continue, without commands, unless necessary, until the command CEASE FIRING!

(7) When exercising without powder, the gun-pointer should fire a primer, or call out FIRE! in order that the exercise may be continued [21].

NOTE.—Electric firing is so much better than percussion that it should always be used, if possible [53]. The percussion lock-lanyard should be led so that the gun can be fired by the pointer, if percussion firing must be used. Care should be taken in arranging this lead that the lanyard is as little in the way as possible, and not liable to be fouled. The lock-lanyard must never be hooked except when plug is closed and locked, and just before cocking it.

Cease Firing!**[60, 61, 62].**

168 (1) Plugman turns plug-crank back just enough to break electric firing-connections at breech-terminals [61].

(2) **1st-loader** carefully extracts primer [2, (5); 105].

(3) Should the command COMMENCE FIRING! be again given, the gun will be primed as under LOAD [51, (7), (8)].

Unload!**[63]**

169. (1) The pointer lays the gun in the loading position.

(2) **Plugman** turns the plug-crank back just enough to break the electric firing-connection at the breech-terminal [61], and, after the primer has been extracted, fully opens breech. Closes breech after gun is unloaded.

(3) **1st-loader** extracts the primer [3, (3), (4)], standing clear of the breech while doing so, and using great care to avoid firing it [105, (4), (5)].

(4) After the breech has been opened, the plugman, 1st- and 2d-loaders, remove the sections of the charge from the gun. The ammunition-car is brought up, the charge placed in it and sent below. (See note, Art. 63, (2), in regard to greasy powder-bags.)

(5) **The plugman and 1st- and 2d-loaders** engage the shell-extractor in the cannelure at the base of the shell, start the shell from its seat, using the spider and screw, if necessary, draw the shell to the rear until the rotating-band is just clear of the chamber and projecting into the screw-box, then put in the loading-tray so that its inner lip is under the base of the shell, bring up the ammunition-car, haul the shell into it and send it below [127].

(6) **Should the shell-extractor fail to work**, the shell may be rammed out from the muzzle using a large spar or strong-back. A block of hard wood, of nearly the diameter of the bore, with a circular iron plate or band on the ends to prevent its being split by the point of the shell, or blows of the spar, should be put in the bore, between the shell and the spar. A large swab, or pad of old canvas, should be put in the chamber, in front of the mushroom-face, and the *breech closed*. The shell may then be rammed to the rear, the breech opened, and the shell hauled out into the ammunition-car [128].

(7) **Using percussion firing**, or in case of a miss-fire, should it

become necessary to unload, see Notes, Articles 3, (4); 11, (3); 101; 105.

Change Stations!

[19]

170. (1) To be used occasionally at drill to familiarize the men with all the duties of the turret, and to show them that each duty requires skill and care to properly perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(2) At the command, every man goes up one station, except plugman, who becomes messenger.

Secure!

[64]

171. (1) The turret will be trained for putting in the tompions and putting on muzzle-bags; then it will be placed in the securing position for sea or port. The rammerman then locks the turret before the current or power is cut off the training-motors [121].

(2) The members of the crew return what they provided and secure what they cast loose.

(3) After actual firing, the members of the crew will assist the gunner's-mates to wash out, clean, dry, and oil the bore [130].

(4) Gun-captains report to the turret-officer when their respective guns are secure.

(5) The members of the crew leave the turret and handling-room and go to their quarters for muster, when ordered by the turret-officer [Part I, 39, (2)].

AMMUNITION-CREW.

172. A junior-officer or petty-officer in charge [35, 36].

(30 men and a gunner's-mate; the gunner's-mate is in charge of ammunition.)

NOTE.—Numbers are necessary for the handling-room crews, owing to the necessary similarity of stations and titles of the men [14, (1), (2)].

For Each Gun.

No.	Title.	Station.
1.	Shellman.	In shell-room.
2.	"	"
3.	"	Outside to handle shell.
4.	"	"
5.	"	Tends overhead trolley-switches.
6.	"	Operates handling-room truck.

7.	Powderman.	Inside magazine.
8.	"	"
9.	"	"
10.	"	Outside to handle powder.
11.	"	"
12.	"	"
13.	"	"
14.	Carman.	Rear end of car, tends clamps and latches and lifts covers.
15.	Messenger.	Communications and signals.

Stations and Duties.

173. (1) **The gunner's-mate** procures the magazine and shell-room keys, and unlocks the doors; sees the magazine and shell-room flood-cocks clear; sees ventilating-blowers open; he shall not permit any person entering the magazines to wear other than magazine shoes while powder is being handled, outside of the tanks; supervises the handling of ammunition.

(2) **1** and **2** ship shell-tongs, hoist, and start shell through the door.

(3) **3, 4, 5,** and **6** ship overhead tracks. Receive shell from **1** and **2**, land it on turn-table of handling-room truck and then shove it into the car, **3** and **4** at the base, **5** and **6** at the point.

(4) **6** operates handling-room truck.

(5) **14** opens shell-latch, lifts powder-cover; closes latch.

(6) **3**, leading man of outside shell-group. Sees latch closed when shell is on car.

(7) **7, 8,** and **9** inside magazine, open tanks, pass sections of powder through door as necessary.

(8) **7**, leading man of inside powder-group.

NOTE.—No more powder will be passed into the handling-room than is necessary to load the cars, and the magazine doors will habitually be kept closed, the powder being passed through the opening in the door provided for that purpose, and the flaps of the opening kept closed except when it is opened for the powder to be passed out, or for necessary communication.

(9) **10, 11, 12,** and **13** in handling-room, connect fire-hose. Receive sections of powder-charges from magazine and place them in the car of the ammunition-hoist, being particularly careful to see that the tie-end of each section is toward the muzzle of the gun [34, (3)].

(10) **10**, leading man of outside powder-group.

(11) **14** provides drinking-water for ammunition-crew, in

magazine water-can. Takes station at rear end of car; tends clamps, latches, and powder-covers on cars.

(12) 15, at voice-pipes, and other communications. Repeats all messages received, to the officer or petty-officer in charge of the handling-room. Signals to turret when cars are ready for hoisting [141].

NOTE.—Large and efficient ammunition-crews are essential for providing an ample supply of ammunition for the guns. They also form the turret reserve, and should be drilled at the guns, in order to be qualified to fill vacancies in the turret. The senior man in each ammunition-crew shall act as captain of that crew.

DRILL FOR 13-INCH SUPERIMPOSED TURRETS. KEARSARGE AND KENTUCKY.

(13-inch Mark II guns on Mark III mounts.)

NOTE.—Attention is especially invited to **Notes on Turret Mounts**, Arts. 113 to 142.

STATIONS.

[14]

174. (1) Turret-officers and turret-captain in the most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) Gun-pointer group consists of two men for each gun-pointer-station and two men for the training-station, called 1st- and 2d-pointers, and 1st- and 2d-trainers. The 1st- and 2d-pointers alternate at pointing and sight-setting, and the 1st- and 2d-trainers alternate at training and sight-setting [28, 54, 56, 57, 93, 94, 95].

(3)

Gun-crew.

Title.

Station.

Plugman.	Plug-crank.
Loader.	Rear and outboard of breech.
Rammerman.	At rammer-controller.
Hoistman.	At hoist-controller.
Messenger.	Communications.
Gunner's-mate.	Wherever needed.

Notes.

175. (1) One member of each gun-crew shall be detailed as gun-captain and shall be stationed with special reference to his overseeing the working of the crew (Part I, Art. 64).

(2) The plugman and loader must be large, strong, active men. The rammerman, hoistman, and messenger must be intelligent, careful men; great strength not required [116, (7)].

(3) Two gunner's-mates must be detailed for the care of the guns and the turret, and one gunner's-mate for the care of the handling-room; one man should be detailed from each gun-crew to assist in the care of the guns and turret [116, (1), (4), (5), (6)].

(4) One electrician must be detailed to care for the electrical appliances in the turret, and at general quarters he should always be present in the turret. This electrician remains in the powder division but is stationed in the turret at drills, and will have general charge of all electrical appliances therein.

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the turret-officer, if necessary.)

176. (1) **CAST LOOSE AND PROVIDE! LOAD!** (designating object, direction, range, and setting of sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and as far as possible without commands.

Stations!

(2) At this command, which may be given at any time, each member of the crew will take his proper station at the gun, stand, and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained; the men stand in their tracks and await orders.

Cast Loose and Provide!

[20 to 32]

(Guns secured for sea or port.)

177. (1) If the port-bucklers are shipped the members of the crew remove them before performing their other duties, plug-man and loader working inside, rammerman, hoistman, and messenger working outside; the turret-apron or water-shed will be raised clear of the barbette, and the turn-buckles and wedges removed by the 2d-pointers and the 2d-trainer [122]. As soon as the port-bucklers and tompions are removed, the gun-pointers will lay the guns in the loading position.

(2) The turret-officer or turret-captain will see that everything is clear outside of the turret before allowing it to be trained.

(3) The 1st-pointer and 1st-trainer take out plugs from peep-holes; take covers off sights; inspect sights and sight-mounts; connect electric firing-wires to battery and ground-terminals

[96]; test firing-circuit [21]; turn on sight-lights; test elevating and training-controllers; close elevating and training-switches and circuit-breakers; test elevating and training-gear to make sure that everything is in working order; lay the guns for the removal of tompions, and then put the guns in loading position. Report anything out of order to the turret-officer; take their stations in the pointing- and training-hoods, set sights and train as directed.

(4) **Gun-captain** reports to the turret-officer when his gun is cast loose and is ready in all respects for loading.

(5) **Plugman** opens breech and inspects breech-mechanism [27; 29; 51, (9)] and gas-check [108, (10)]; sees that electric firing-wires are properly connected to breech-terminal, plug-terminal, and lock-terminal; inspects the lock and tries it to make sure that it is in working order [97]; sees priming-wire, boring-bit and vent-cleaner in place and ready for use [26]; provides himself with a hand primer-extractor; takes station at plug-crank facing to the rear; reports anything not in working order to the gun-captain [114].

(6) **Loader** provides loading-tray [39] and places it convenient for use; sees bristle- and marine-sponges in place [26, (2); 31, (4)]; sees lock-lanyard ready for use [26]; examines the bore, making sure that it is clear of obstructions, and reports "Bore clear" [32]; provides himself with primers [21, (2)]; takes station outboard and to the rear of breech; reports anything not in working order to the gun-captain.

(7) **Rammerman** unlocks turret as soon as current is on the training-motors; tries rammer-controller; closes rammer-switch and circuit-breaker [134, 135]; sees that current is on and tests rammer; sees that friction-nut is set to correct mark [137]; takes station at rammer-controller; reports anything not in working order to the gun-captain.

(8) **Hoistman** removes muzzle-bag and tompion, and reports same to the gun-captain [22]; tests hoist-controller; closes hoist-switch and circuit-breaker; after warning handling-room, tests hoist [113, (8)]; takes station at hoist-controller; reports anything not in working order to the gun-captain.

(9) **Messenger** fills gun-tub with fresh water [31, (7,c)]; provides bucket of fresh water for marine-sponge and places it outboard of breech [48, (2)]; takes station at telephone, voice-pipes, and battle-order indicator; reports all messages received to the turret-officer; tests and sees air-blast in working order, unless this duty is assigned to some other member of the crew.

(10) **Electrician** turns on turret lights if necessary; examines circuits, fuses, switches, and circuit-breakers; sees circuit-breaker springs set at proper tension; tests smoke-fans; provides himself with spare fuses for all circuits, and necessary spare parts and tools for making repairs to electric apparatus [134, 135, 136].

(11) **Gunner's-mate** notifies dynamo-room to turn current on the turret; takes station near turret-officer ready to assist in overcoming any difficulties. The gunner's-mate will keep in the turret, ready for use, in racks or lockers, the articles enumerated under Notes, Art. 109.

Load!

[32 to 40, 47, 48, 49, 51]

(The gun having been fired.)

178. (1) **1st-pointer** lays gun in loading position, the second pointer warning him to do so.

(2) **The plugman** opens the breech while the gun is being brought to loading position (see note below on precautions to be taken when firing both guns); extracts fired primer, in case it has not been done; examines electric firing-connections, lock and gas-check, clears vent if necessary [30; 51, (19)]; wipes off mushroom-head with marine-sponge [48]; feels of mushroom-head and, if hot, reports to turret-officer.

NOTE.—When firing both guns with present powder which leaves a combustible gaseous residue, the breech of the gun fired must not be opened if powder is exposed in the operation of loading the other gun, unless a thoroughly tested and officially approved appliance for clearing the bore of gases is used (see Art. 4).

(3) **The messenger** or other designated member of the crew turns on air-blast; turns it off when bore is reported clear [107].

(4) **The rammerman** kicks down loading-platform as soon as gun is fired.

(5) **The loader** extracts primer while breech is being opened; enters loading-tray and sees bore clear of smoke and gases [39, 40], steps back and reports "Bore clear" [51, (10)].

(6) **The rammerman** raises loading platform.

(7) **The hoistman**, as soon as car is loaded and bore of gun is reported clear, hoists car to loading position. (See Dept. Special Order No. 44, October 31, 1903.) [4, (1); 113, (8).]

(8) **The loader** raises shell-latch as car comes to loading position, and assisted by plugman keeps powder clear of rammer [2, (7); 123].

(9) The rammerman rams shell home, withdraws rammer [33; 118, (1)].

(10) The plugman and loader roll first two sections of powder into trough.

(11) The rammerman rams first two sections of powder inside of breech; withdraws rammer [2, (6); 34; 123].

(12) The hoistman works powder dump-wheel and allows last two sections of powder to drop into shell-trough in front of rammer.

(13) Plugman and loader assist as before.

(14) The hoistman raises car off loading-hook.

(15) The rammerman rams last two sections of charge until the rear end is just clear of the loading-tray; gives word *Down car* as soon as powder is clear of car [34; 51, (11)].

(16) The hoistman lowers car to handling-room.

(17) The rammerman kicks down loading-platform as soon as car is clear; withdraws rammer as soon as powder is in position.

(18) The loader sees rear end of charge in proper position to take against mushroom-face with ignition charge in front of vent; removes loading-tray, and, if necessary, wipes out gas-check seat and screw-box with marine-sponge [48].

(19) The plugman closes the breech, stopping just before electric connection is made to allow the loader to insert primer [61].

(20) The loader stands ready with primer [2, (1); 51, (16)] (see Dept. Special Order No. 28, August 28, 1902); when breech is nearly closed, signals to plugman to stop [61]; inserts primer [105, (3)], closes lock, stands clear and signals to plugman to close breech completely.

(21) The rammerman raises loader's-platform.

(22) When gun is ready to be fired and every one is clear of the recoil, the plugman fully closes the breech [61] and taps the pointer on the leg with his hand as a signal that the gun is ready to be fired.

NOTE.—If percussion firing-mechanism is to be used, plugman closes breech entirely. When breech is closed the loader inserts primer, hooks lock-lanyard, cocks lock and stands clear. The rammerman raises loader's-platform and the plugman taps pointer on the leg [2, (2), (3); 58].

Commence Firing!

[52 to 60]

179. (1) The pointer points and fires the gun, aiming as directed [38, 57].

- (2) The trainer keeps the turret trained as directed [38, 57].
- (3) The pointer not firing sets pointer's-sight as directed.
- (4) The trainer not training sets trainer's-sight as directed.
- (5) The first- and second-pointer and the first- and second-trainer stand by to relieve each other.

(6) The loading and firing continue without commands, unless necessary, until the command CEASE FIRING!

(7) In exercising without powder the gun-pointer should fire a primer or call out FIRE! in order that the exercise may be continued [21].

NOTE.—Electric firing is so much better than percussion that it should always be used if possible [53]. The percussion lock-lanyard should be led so that the gun can be fired by the pointer if percussion firing must be used. Care should be taken in arranging this lead that the lanyard is as little in the way as possible, and not liable to be fouled. The lock-lanyards must never be hooked, except after plug is closed and locked and just before it is being cocked.

Cease Firing!

[60, 61, 62]

180. (1) **The plugman** turns the plug-crank back just enough to break the electric firing-connections at breech-terminal [61].

(2) **The loader** carefully extracts primer [2, (5); 105].

(3) Should the command COMMENCE FIRING! be again given, the gun will be primed as under LOAD! [51, (7), (8)].

Unload!

[63]

181. (1) **The pointer** lays the gun in loading position.

(2) **The plugman** turns the plug-crank back just enough to break the electric firing-connections at breech-terminal [61], and, after primer has been extracted, fully opens breech; closes breech after the gun is unloaded.

(3) **The loader** extracts primer [3, (3), (4)] standing clear of breech while doing so, and using great care to avoid firing it [105].

(4) After breech has been opened the plugman and loader remove the sections of the charge from the gun. The ammunition-car is brought up, the charge is placed in it and sent below. (See note, Art. 63, (2), in regard to greasy powder-bags.)

(5) **The plugman and loader** engage the shell-extractor in the cannelure at the base of the shell; start the shell from its seat, using the spider and screw if necessary; draw the shell to the rear until the rotating-band is just clear of the chamber and pro-

jecting into the screw-box; put in the loading-tray so that its inner lip is under the base of the shell. Bring up the ammunition-car, haul the shell into it, and send it below [127].

(6) **Should the shell-extractor fail to work**, the shell may be rammed out from the muzzle, by using a large spar or strong-back. A block of hard wood, of nearly the diameter of the bore, with circular iron plates, or bands, on the ends to prevent its being split by the point of shell, or blows of the spar, should be put in the bore between the shell and the spar. A large swab, or pad of old canvas, should be put in the chamber, in front of the mushroom-face, and the breech closed. The shell may then be rammed to the rear, the breech opened and the shell hauled out into the ammunition-car [128].

(7) **Using percussion firing**, or in case of a miss-fire, should it become necessary to unload, see Notes, Articles 3, (4); 11, (3); 101; 105.

Change Stations!

[19]

182. (1) **To be used occasionally at drill** to familiarize the men with all the duties of the turret, and to show them that each duty requires care and skill properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(2) At the command, every man goes up one station, except the plugman, who becomes messenger.

Secure!

[64]

183. (1) **The turret will be trained** for putting in the tompions and putting on muzzle-bags; then it will be placed in the securing position for sea or port. The rammerman then locks the turret before the current or power is cut off the training-motors [121].

(2) The members of the crew return what they provided, and secure what they cast loose.

(3) After actual firing, the members of the crew will assist the gunner's-mate to wash out, clean, dry, and oil the bore [130].

(4) Gun-captains report to the turret-officer when their respective guns are secure.

(5) The members of the crew leave the turret and handling-room and go to their quarters for muster, when ordered by the turret-officer [Part I, 39, (2)].

AMMUNITION-CREW.

184. A junior-officer or petty-officer in charge [35, 36].

(30 men and a gunner's-mate; gunner's-mate in charge of ammunition.)

NOTE.—Numbers are necessary for the handling-room crews owing to the necessary similarity of the stations and titles of the men [14, (1), (2)].

For Each Gun.

No.	Title.	Station.
1.	Shellman.	At trolley.
2.	"	"
3.	"	"
4.	"	"
5.	"	At truck.
6.	"	"
7.	Carman.	At car, tends catch.
8.	Magazine door-keeper.	At magazine door.
9.	Powderman.	Handles powder.
10.	"	"
11.	"	"
12.	"	"
13.	"	"
14.	"	"
15.	Messenger.	At voice-pipe and signal-lights.

Stations and Duties.

185. (1) The gunner's-mate procures the magazine and shell-room keys; unlocks doors; sees magazine and shell-room flood-cocks clear; sees ventilating louvres open; and he shall not permit any person to enter the magazine wearing other than magazine shoes while powder is being handled outside of the tanks. Supervises the handling of ammunition.

(2) 1, 2, 3, and 4 ship shell-tongs, hoist shell, take it out into handling-room and land it on truck.

(3) 5 and 6 operate handling-room truck, receive shell at truck, assist to land it, then shove it into car.

(4) 7 tends catch at car.

(5) 8 tends magazine door, opening it as car comes down to allow powdermen to get out with powder, closing it when they are out, opening it for them to re-enter, and closing it after them.

NOTE.—No more powder will be taken into the handling-room than is necessary to load the cars, and the magazine doors will habitually be kept closed except when they are opened for the powderman to pass in and out, or for necessary communication.

(6) 9, 10, 11, and 12 open powder-tanks and each takes a section of a charge in his arms; as soon as door is opened, load powder into car and return at once to magazine [34, (3)].

(7) 13 and 14 in lower magazines to pass powder to upper magazine. Each provides a bucket of water for ammunition-crew.

(8) 15 at rear end of car. Tends powder-cover of car; signals to turret when car is ready for hoisting; reports all messages received through voice-pipe to officer in charge of handling-room [141].

NOTE.—Large and efficient ammunition-crews are essential for providing an ample supply of ammunition for the gun. They also form the turret reserve, and should be drilled at the guns, in order to be qualified to fill vacancies in the turret. The senior man in each ammunition-crew shall act as captain of the crew.

DRILL FOR 13-INCH TURRETS. INDIANA CLASS.

13-inch guns Mark I and II, on Mark II mount (hydraulic or steam training; hydraulic ammunition-hoists and rammers).

NOTE.—Attention is especially invited to **Notes on Turret Mounts**, Arts. 113 to 132, and 142 to 161.

STATIONS.

[14]

186. (1) **Turret-officer and turret-captain** in the most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) **The gun-pointer group** consists of two men for each pointing- and training-station, called 1st- and 2d-pointers and 1st- and 2d-trainers. The 1st- and 2d-pointers alternate in pointing and sight-setting, and the 1st- and 2d-trainers alternate in training and sight-setting [28, 54, 56, 57, 93, 94, 95].

(3)

Gun-crew.

Title.

Station.

Plugman.	At plug-crank.
1st-loader.	Rear of gun, on loader's-platform.
Rammerman.	At rammer-valve.
Hoistman.	At hoist-valve.
2d-loader.	Rear of gun, outboard of girder.
Messenger (right)	Communications.
Messenger (left).	Turret-officer's messenger.
Gunner's-mate.	Wherever needed.

Notes.

187. (1) One member of each gun-crew shall be detailed as gun-captain, and shall be stationed with special reference to his overseeing the working of the crew (Part I, Art. 64).

(2) The plugman and 1st-loader must be large, strong, active men. The rammerman, hoistman, 2d-loader, and messenger should be intelligent, careful men; great strength is not required [116, (7)].

(3) Two gunner's-mates must be detailed for the care of the guns and turret, and one for the handling-room. As assistants to the gunner's-mates, one man should be detailed from each gun-

crew, preferably from the pointer's group [116, (1), (4), (5), (6)].

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the turret-officer when necessary.)

188. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and the setting of the sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

• **NOTE.**—Very few commands should be necessary. The firing of the gun is the signal to at once prepare the gun for another discharge; the crew should be trained to work in silence, and, as much as possible, without commands.

Stations!

(2) At this command, which may be given at any time, each member of the crew will take his proper station at the gun, stand, and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained. The men stand in their tracks and await orders.

Cast Loose and Provide!

[20 to 32]

(Guns run in and secured for sea or port.)

189. (1) If the port-bucklers are shipped, the members of the crew remove them before performing their other duties; the pointers, plugmen, 1st-loader, and rammermen working on the inside, and hoistmen, 2d-loaders, and messengers working outside. The turret-apron or water-shed will be raised clear of the barbette, and the turn-buckles or wedges removed [122]. As soon as the turret can be trained, it should be placed in the most convenient position for removing the port-bucklers and tompions. As soon as the port-bucklers and tompions are removed, the gun-pointers will lay the guns in the loading position.

(2) **The turret-officer or turret-captain** sees that everything is clear outside of the turret, before allowing it to be trained.

(3) **The 1st- and 2d-pointers and 1st- and 2d-trainers** take the plugs out of the peep-holes and sight-holes in the sighting-hoods; take the caps off the telescopes; inspect sights and sight-mounts; connect electric firing-wires to battery and ground terminals [96]; test firing-circuits [21]; turn on sight-lights; make sure that the

steam and hydraulic pressure is on the turret; test the elevating and training-gear; lay the turret and guns for the removal of the port-bucklers and tompions; put the guns in the loading position; report anything out of order to the turret-officer; take their stations in the pointing- and training-hoods.

(4) **The gun-captain** reports to turret-officer when his gun is cast loose, and ready in all respects for loading.

(5) **Plugman** assists 1st-loader to remove the holding-out chocks; opens the breech and inspects the gas-check [108, (10)] and breech-mechanism [27; 29; 51, (9)]; sees that the electric firing-wires are properly connected to breech-terminal, plug-terminal, and lock-terminal; inspects the lock and tries it to make sure that it is in working order [97]; sees that the priming-wire and boring-bit are in place and ready for use [26]; provides himself with a hand primer-extractor; takes station at plug-crank; reports anything not in working order to the gun-captain [114].

(6) **1st-loader** removes holding-out chocks; places the loading-tray on girder near the breech [39]; sees the bristle-sponge and marine-sponge ready for use [26; 31, (4)]; sees lock-lanyard ready for use [26]; examines the bore, making sure that it is clear of obstructions, and when satisfied reports "Bore clear" [32]; provides himself with primers [21, (2)]; takes station on the loader's-platform in rear of gun; reports anything not in working order to the gun-captain.

(7) **Rammerman** turns the pressure on the rammer and sees that the exhaust-valves are open; satisfies himself that the rammer is in working order; turns on the smoke-fan; takes station at the rammer; tests air-blast and sees it in working order; reports anything not in working order to the gun-captain.

(8) **Hoistman** takes out tompion [22]; turns pressure on the ammunition-hoist; sees the exhaust-valve open; tests hoist [113, (8)]; takes station at hoist-valve lever; reports anything not in working order to the gun-captain.

(9) **2d-loader** fills the gun-tub with fresh water [31, (7, c)]; provides two marine-sponges and places them in gun-tub [48, (2)]; tends the rest-lug lever, putting it as ordered; tends the turret-locks on his side of the turret, unlocking the turret when the steam is on; takes station outside of the girder in rear of plugman.

(10) **Messenger (right)** takes station at the telephone and battle-order indicators; repeats to the turret-officer all messages that he receives.

(11) **Messenger (left)** reports to the turret-officer for duty as

messenger. In absence of messenger (right) performs duties of that station.

(12) **Gunner's-mate.**—The gunner's-mate turns the pressure on the turret and sees that all exhaust-valves are open; adjusts the relief-valves, if necessary; opens the gun-working valves and runs out the guns, if they are run in, as soon as the port-bucklers are removed; goes in the turret to assist, if necessary, in overcoming any hitch or accident; provides locks, primers, priming-wires, if these are not already in place. The gunner's-mate will keep in the turret ready for use, in racks, or in a locker, the articles enumerated under Notes, Art. 109.

Load!

[32 to 40, 47, 48, 49, 51]

(The gun having been fired.)

190. (1) **1st-pointer** lays the gun in the loading position, the 2d-pointer warning him to do so; then takes up the pointing with the other gun.

(2) **2d-pointer** sets sight as directed.

(3) **The plugman** opens the breech while the gun is being brought to the loading position and holds it open; takes out fired primer; examines the electric firing-connections, lock, and gas-check [108, (10)]; clears the vent, if necessary [30; 51, (19)]; wipes off mushroom with marine-sponge [48]; feels of mushroom-head, and reports to turret-officer if it is hot.

NOTE.—When firing with both guns with the present powder, which leaves a combustible gaseous residuum, the breech of the gun will not be opened if powder is exposed in the operation of loading the other gun. This note does not apply to guns which are fitted with a thoroughly tested and officially approved method of expelling gases from the bore [see Art. 4].

(4) **The rammerman** stands by with the air-hose, or if so fitted, opens the air-blast; directs the air into the breech; closes air-blast when bore is clear [107].

(5) **The 2d-loader** puts the rest-lugs in the loading position, if they are not in that position already.

(6) **The 1st-loader** enters the loading-tray as soon as possible [39, 40]; inspects bore, and when clear reports "Bore clear" [51, (10)]; steps back and raises the loader's-platform.

(7) **The hoistman**, as soon as the ammunition-car is loaded, hoists it under the loader's-platform; when platform is clear, brings the car to the 1st loading position, removes the front pin [4, (1); 113, (8)].

(8) **The 1st-loader** holds up rear latch.

(9) **The rammerman** rams home shell; withdraws rammer [33; 118, (1)].

(10) **The hoistman** puts the car in 2d position.

(11) **The 1st-loader** takes out rear pin.

(12) **The rammerman** rams 1st two sections of charge in until inside of the gas-check seat; withdraws the rammer [2, (6), (7); 34; 123].

(13) **The hoistman** puts the car in 3d position.

(14) **The rammerman** rams the last two sections of the charge just clear of the screw-box; withdraws rammer [51, (11)].

(15) **The hoistman** lowers the car to the handling-room.

(16) **The 1st-loader** lowers the loader's-platform as soon as the car is clear; sees the rear end of charge in proper position to take against the face of the mushroom-head, with ignition-charge in front of vent [34; 51, (11)]; removes the loading-tray; wipes off the gas-check seat and screw-box, if necessary, with a marine-sponge which he receives from the 2d-loader [48].

(17) **The plugman** closes the breech, stopping just before electric connection is made, to allow 1st-loader to insert the primer [61]; then fully closes the breech.

(18) **1st-loader** stands ready with the primer [2, (1); 51, (16)]; when the breech is nearly closed signals to plugman to stop [61]; inserts primer [105, (3)]; closes lock, stands clear, and signals to plugman to close breech.

(19) If the pointer is waiting for the gun, he will commence to raise the gun to the loading position as soon as the loading-tray is out of the gun, to avoid, as much as possible, loss of time.

(20) When the gun is ready to be fired, and everyone is clear of the recoil, **the plugman** will completely close the breech [61] and tap the pointer on the leg with his hand, as a signal that the gun is ready to be fired.

NOTE.—If percussion firing-mechanism [53] is to be used, the plugman closes breech entirely. When breech is closed the 1st-loader inserts primer, hooks lock-lanyard, cocks lock and stands clear. The plugman taps pointer on the leg as a signal that the gun is ready.

Commence Firing!

[52 to 60]

191. (1) **The pointer** points and fires the gun, aiming as directed by the turret-officer [38, 57].

(2) **The trainer** keeps turret trained on the target [38, 57].

(3) **The 2d-pointer** sets pointer's-sight as directed by the turret-officer.

(4) **The 2d-trainer** sets the trainer's-sight.

(5) **The 2d-pointer and 2d-trainer** stand by to relieve the 1st-pointer and 1st-trainer should they become fatigued.

(6) The loading and firing continue without commands, unless necessary, until the command, CEASE FIRING!

(7) When exercising without powder, the gun-pointer should fire a primer, or call out FIRE! in order that the exercise may be continued [21].

(8) **Messenger (right)** keeps the turret-officer constantly informed of the range and all orders and information that he receives over the telephone.

(9) **The 1st-pointer** fires one gun of the pair while the other is being loaded. When one of the guns has fired he and the 2d-pointer shift at once to the other.

NOTE.—Electric firing is so much better than percussion that it should always be used, if possible [53]. The percussion lock-lanyard should be so led that the gun can be fired by the pointer, if percussion firing must be used. Care should be taken in arranging this lead that the lanyard is as little in the way as possible. The lock-lanyard shall never be hooked except when plug is closed and locked and just before cocking it.

Cease Firing!

[60, 61, 62]

192. (1) **The plugman** turns the plug-crank back just enough to break the electric firing-connections at breech-terminal [61].

(2) **The loader** carefully extracts primer [2, (5); 105].

(3) Should the order, COMMENCE FIRING! be again given, the gun will be primed as under LOAD! [51, (7), (8)].

Unload!

[63]

193. (1) **The pointer** lays the gun in the loading position; the 2d-loader putting the rest-lug in the loading position, if it is not already there.

(2) **The plugman** opens the breech just enough to break the electric connection [61], and, after the primer has been extracted, fully opens it; closes breech after gun is unloaded.

(3) **The 1st-loader** extracts the primer [3, (3), (4)], standing clear of the breech while doing so and using great care to avoid firing it [105, 106].

(4) **1st- and 2d-loader and rammerman** remove the sections of the charge from the gun after the breech has been opened. The ammunition-car is brought up, the charge is placed in it, and sent

below. (See note, Art. 63, (2), in regard to greasy powder-bags.)

(5) The gun is then brought to the level position; the 2d-loader tending the rest-lug; 1st- and 2d-loaders and rammerman engage the shell-extractor in the cannelure at the base of the shell; start the shell from its seat, using the spider and screw, if necessary; draw the shell to the rear until the rotating-band is just clear of the chamber and projecting into the screw-box; then put in the loading-tray so that its inner lip is under the base of the shell; bring up the car; haul shell into the upper chamber and send it below [127; 128; 181, (6)].

(6) Using percussion firing, or in case of a miss-fire, should it become necessary to unload, see Articles 3, (4); 11, (3); 101; 105.

(7) After a miss-fire, the gun will not be unloaded, nor the breech opened, in less than 20 minutes. See notes on miss-fires [98 to 104].

NOTE.—A miss-fire in this sense means that the primer has fired and the gun has failed to go off.

Change Stations!

[19]

194. (1) To be used occasionally at drill to familiarize the men with all the duties of the turret, and to show them that every duty requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(2) At the command, every man goes up one station, except the plugman, who becomes messenger.

Secure!

[64]

195. (1) The turret will be trained for putting in the tomions and putting on muzzle-bags; then it will be placed in the securing position for sea or port. The rammerman then locks the turret before the current or power is cut off the training-motors [121].

(2) The members of the crew return what they provided and secure what they cast loose.

(3) After actual firing, the members of the crew will assist the gunner's-mate to wash out, clean, dry, and oil the bore [130].

(4) Gun-captains report to the turret-officer when their respective guns are secure.

(5) The members of the crew leave the turret and handling-room and go to their quarters for muster, when ordered by the turret-officer [Part I, 39, (2)].

AMMUNITION-CREW.

[35, 36]

196. A junior-officer or a petty-officer in charge.

(24 men and a gunner's-mate. Gunner's-mate is in charge of the ammunition.)

NOTE.—Numbers are necessary for the handling-room crews, owing to the necessary similarity of the stations and titles of the men [14, (1), (2)].

For Each Gun.

No.	Title.	Station.
1.	Shellman.	In shell-room.
2.	"	"
3.	"	"
4.	"	Outside, handles shells.
5.	"	" " "
6.	"	" " "
7.	Powderman.	In magazine.
8.	"	"
9.	"	"
10.	"	Outside, handles powder.
11.	"	" " "
12.	(Right) messenger.	Operates ram, tends voice-pipe.
12.	(Left) carman.	Tends the latches and pins on ammunition-car.

Stations and Duties.

197. (1) The petty-officer.—General duties, in charge of the ammunition-crew.

(2) **Gunner's-mate** procures the magazine and shell-room keys; unlocks the doors; supervises the handling of powder in the magazines [173, (1)].

(3) 1, 2, and 3 ship shell-tongs, hoist and start the shell through the door.

(4) 1, leading man of shell-handling group.

(5) 4, 5, and 6 ship overhead tracks; receive the shell from the shell-room, land it on the turn-table of handling-room truck,

bring the truck to the ammunition-car, and lock the truck to the car-track.

(6) 12 (right) operates the ram and rams the shell into the ammunition-car; signals to the turret when the car is ready for hoisting.

(7) 12 (left) assists 12 (right), and tends the latch and pins on the ammunition-car.

(8) 7, 8, and 9, inside the magazine, open tanks; pass sections of charge through the door, as necessary.

(9) 7, leading man of inside powder-group.

NOTE.—No more powder will be passed into the handling-room than is necessary to load the cars, and the magazine doors will habitually be kept closed, the powder being passed through the opening in the door provided for that purpose, and the flap of the opening kept down, except when it is opened for the powder to be passed out, or for necessary communication. While the powder is in the car, waiting to be hoisted to the turret, it should be covered to protect it from water leaking from the hydraulic system.

(10) 10 and 11, in handling-room, connect fire-hose in handling-room; receive sections of the charge from the magazine, and place them in the ammunition-car, using care to see that the tie-end of each section is toward the muzzle of the gun [34, (3)].

(11) 12 (right), at the voice-pipe and other communications, repeats to the officer in charge of the handling-room all messages that he receives; signals to turret when the car is ready for hoisting [141].

(12) 12 (left) provides the drinking-water for the ammunition-crew; takes station at the rear end of the ammunition-cars; assists to operate the shell-ram, and tends the latch and pins of the ammunition-cars.

NOTE.—Large and efficient ammunition-crews are essential for providing an ample supply of ammunition for the guns. They also form the turret reserve, and should be drilled at the guns, in order to be qualified to fill vacancies in the turret. The senior man in each ammunition-crew shall act as captain of that crew.

DRILL FOR 12-INCH TURRETS. U. S. S. IOWA.

12-inch, B. L. R. hydraulic-trained turret, spring-return mounts, hand elevation, electric rotary-rammers, hydraulic hoists, Mark II guns on Mark III mounts.

NOTE.—Attention is especially invited to **Notes on Turret Mounts**, Arts. 113 to 161.

STATIONS.

[14]

198. (1) The **turret-officer** and **turret-captain** in the most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) **Gun-pointer group** consists of two men for each gun-pointer station and two men for the training-station, called 1st- and 2d-pointers and 1st- and 2d-trainers. The 1st- and 2d-pointers alternate at pointing and sight-setting, and the 1st- and 2d-trainers alternate at training and sight-setting [28, 54, 56, 57, 93, 94, 95].

(3) **Gun-crew.**

Title.

Station.

Plugman.	At plug-crank.
1st-loader.	Inboard of rammer.
Rammerman.	" " "
Hoistman.	At hoist-valves.
2d-loader.	Outboard of rammer.
Elevatorman.	Elevating-crank.
Messenger.	Communications.
Gunner's-mate.	Wherever needed.

Notes.

199. (1) One member of each gun-crew shall be detailed as gun-captain, and shall be stationed with special reference to his overseeing the working of the crew (Part I, Art. 64).

(2) The plugman and 1st-loader must be large, strong, active men. The hoistman and rammerman must be intelligent, careful men; great strength is not required [116, (7)].

(3) Two gunner's-mates must be detailed for the care of the guns and turret, and one gunner's-mate for the care of the handling-rooms. One man should be detailed from each gun-crew to

assist in the care of the gun and the turret [116, (1), (4), (5), (6)].

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the turret-officer, if necessary.)

200. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and also the setting of the sight for lateral compensation); **COMMENCE FIRING!** **CEASE FIRING!** **UNLOAD!** **SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

Stations!

(2) At this command, which may be given at any time, each member of the crew will take his proper station at the gun, stand, and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained, the men stand in their tracks and await orders.

Cast Loose and Provide!

[20 to 32]

(Guns secured for sea or port.)

201. (1) If the port-bucklers are shipped, the 1st- and 2d-pointers and 1st- and 2d-trainers will remove them before performing their other duties. The turret-apron or water-shed will be raised, and the turn-buckles or wedges removed by the rammermen, 2d-loaders, and the elevatormen [122]. Hoistmen will remove muzzle-bags and tompions.

(2) As soon as the port-bucklers and tompions are removed, the gun-pointers will lay the guns in loading position.

(3) **The turret-officer, or turret-captain,** will assure himself that everything is clear outside of the turret before allowing it to be trained.

(4) **1st-pointer** removes plugs from peep-holes in sighting-hood, removes cover from sights, turns on sight-lights, assists to remove port-bucklers; lays the guns for removal of tompions; takes station in the pointing-hood.

(5) **2d-pointer** connects up firing-attachment [96] and tests firing-circuit [21], making sure that all connections are secure; tests elevating-gear; assists to remove port-bucklers; takes station as sight-setter in pointing-hood.

(6) **1st-trainer** removes the plugs from the peep-holes in the training-hood, removes the cover from the training-sight; assists to remove the port-bucklers; takes station in training-hood and trains as directed.

(7) **2d-trainer** turns pressure on the training-motor, and when the turn-buckles are off, tests the training-gear; assists to remove the port-bucklers; takes station as sight-setter in training-hood.

(8) **The gun-captain** reports to turret-officer when his gun is cast loose and ready in all respects for loading.

(9) **Plugman** opens breech and inspects gas-check [108, (10)] and breech-mechanism [27; 29; 51, (9)]; sees that the electric firing-wires are properly connected to breech-terminals; inspects the lock and tries it to make sure that it is in working order [97]; sees priming-wire, boring-bit, and vent-cleaner in place and ready for use [26]; provides himself with a hand primer-extractor; takes station at plug-crank, facing to the rear; reports anything not in working order to the gun-captain [114].

(10) **1st-loader** provides bristle- and marine-sponges; fills gun-tub with fresh water and places marine-sponges in it [31, (7,c); 48, (2)]; examines the bore, making sure that it is clear, and when satisfied reports "Bore clear" [32]; examines gas-check seat, to see that it is clear and is not scored; provides himself with primers [21, (2)]; takes station inboard of rammer, in rear of gun; reports anything not in working order to the gun-captain.

(11) **Rammerman** removes securing turn-buckles; closes rammer-switch and circuit-breaker; tests rammer [134, 135, 137]; takes station at rammer-controller, inboard of rammer; reports anything not in working order to gun-captain.

(12) **Hoistman** removes muzzle-bag and tompion [22]; turns pressure on hoist-motors; tests hoist [113, (8)], after warning handling-room; takes station at hoist-valves; reports anything not in working order to gun-captain.

(13) **2d-loader** assists to remove securing turn-buckles; assists 1st-loader to provide fresh water [31, (7,c)], and marine-sponges [48, (2)]; sees loading-tray in place [39]; takes station outboard of rammer.

(14) **Elevatorman** assists to remove securing turn-buckles;

tests elevating-gear; takes station at elevating-wheel, outboard of the gun; reports anything out of order to the gun-captain.

(15) **Messenger** takes station at telephone, voice-pipes, and battle-order indicator; reports all messages received to the turret-officer, and also calls his attention to the indications on the battle-order and range-indicator receivers.

(16) **Gunner's-mates** notify engine-room to turn pressure on the turret; open main pressure-valves; see all exhaust-valves open; provide locks, primers, and priming-wires, if these are not already in place; takes station near turret-officer ready to assist in overcoming any difficulty. The gunner's-mate will keep in the turret, in racks or in a locker, the articles enumerated in Notes, Art 109.

Load!

[32 to 40, 47, 48, 49, 51]

(The gun having been fired.)

202. (1) **1st-pointer** lays gun in loading position, the second pointer warning him to do so.

(2) **Plugman** opens the breech while the gun is being brought to the loading position (see note below, on precaution to be taken when firing both guns); extracts the fired primer, in case it has not been done; examines electrical firing-connections, lock, and gas-check [108, (10)]; clears vent if necessary [30; 51, (19)]; wipes off mushroom-head with marine-sponges [48]; feels of mushroom-head, and, if hot, reports to turret-officer.

NOTE.—When firing with both guns with the present powder, which leaves a combustible gaseous residuum, the breech of the gun fired will not be opened if powder is exposed in the operation of loading the other gun. This note does not apply in the case of guns fitted with a thoroughly tested and officially approved appliance for expelling the combustible gases from the bore.

(3) **One of the loaders** opens blast to blow out breech; closes it when bore is clear.

(4) **1st-loader** assisted by 2d-loader puts down the loader's-platform, and, if possible, extracts fired primer while breech is being opened.

(5) **2d-loader** passes loading-tray [39] to 1st-loader, who puts it into the gun as soon as the breech is open. 1st-loader sees that bore is clear of smoke and gases and reports, when bore is clear [32]. (See Dept. Special Order No. 44, October 31, 1903.)

NOTE.—When air-blast is used, it may be necessary to interchange above duties of 1st- and 2d-loaders.

- (6) **The hoistman** starts car up from the handling-room [113, (8)].
- (7) **1st- and 2d-loaders** raise the loader's-platform and step back.
- (8) **The hoistman** puts the ammunition-car in the first position, the plugman tending the pawl on car.
- (9) **The rammerman** rams projectile home; withdraws rammer [33; 118, (1)].
- (10) **The hoistman** puts hoist car in 2d position.
- (11) **The rammerman** rams first two sections of charge just inside of gas-check seat, withdraws rammer [2, (6), (7); 34; 123].
- (12) **The hoistman** puts car in 3d position, the 1st-loader tending pawl on car.
- (13) **The rammerman** rams last two sections of charge, taking care to have the rear of the last section just clear of the loading-tray; withdraws rammer [51, (11)].
- (14) **The hoistman** as soon as last section of charge is clear of the car, takes the weight of the car. The 1st-loader places the pawl for lowering, and hoistman lowers car to handling-room [113, (8)].
- (15) As soon as the car is clear 1st- and 2d-loaders lower the loader's-platform; 1st-loader removes the loading-tray, passing it to 2d-loader. 1st-loader wipes out the screw-box, if necessary, with a marine-sponge [48] which he receives from 2d-loader.
- (16) **The plugman** closes the breech as soon as the loading-tray is out of the gun and the screw-box clear, stopping just before electrical connection is made to allow 1st-loader to insert primer [61].
- (17) **1st-loader** stands ready with primer [51, (16)], (see Dept. Special Order No. 28, August 28, 1902), when breech is nearly closed signals to plugman to stop [61], inserts primer [105, (3)], closes lock, stands clear and signals to plugman. 1st- and 2d-loaders raise loader's-platform.
- (18) When the gun is ready to be fired, and every one is clear of the recoil, plugman fully closes the breech and taps the pointer on the leg with his hand, as a signal that the gun is ready to be fired.
- NOTE.—**If percussion firing-mechanism [53] is to be used, the plugman closes breech entirely. When breech is closed 1st-loader inserts primer, hooks lock-lanyard, cocks lock, stands clear [2, (2)]. 1st- and 2d-loaders raise loader's-platform, the plugman then gives signal to firing-pointer.

Commence firing!**[52 to 60]**

203. (1) **The pointer** points and fires the gun, aiming as directed [38, 57].

(2) **The trainer** keeps the turret trained as directed [38, 57].

(3) **The pointer not pointing** sets pointer's sight as directed.

(4) **The trainer not training** sets the trainer's sight as directed.

(5) **The 1st- and 2d-pointers** and the 1st- and 2d-trainers stand by to relieve each other.

(6) The loading and firing continue without commands, unless necessary, until the command **CEASE FIRING!**

(7) When exercising without powder the gun-pointer should fire a primer or call out **FIRE!** in order that the exercise may continue.

NOTE.—Electric firing is so much better than percussion that it should always be used if possible [53]. The percussion lock-lanyard should be led so that the gun can be fired by the pointer, if percussion firing must be used. Care should be taken in arranging this lead so that the lanyard is as little in the way as possible, and not liable to be fouled; the lock-lanyard must never be hooked except after the plug is closed and locked and just before it is cocked.

Cease Firing!**[60, 61, 62]**

204. (1) **The plugman** turns plug-crank back just enough to break the electrical firing-connection at breech-terminals [61].

(2) **1st-loader** carefully extracts the primer [2, (5); 105]. Should the command **COMMENCE FIRING!** again be given, the gun will be primed as under **LOAD!** [51, (7), (8)].

Unload!**[63]**

205. (1) **The pointer** lays the gun in loading position.

(2) **The plugman** turns the plug-crank back just enough to break the electrical firing-connection at the breech-terminals [61], and, after the primer has been extracted, fully opens the breech, closes breech after gun is unloaded.

(3) **1st-loader** extracts the primer [3, (3), (4)], standing clear of the breech while doing so, and using great care to avoid firing it [105, 106].

(4) **After the breech has been opened**, the plugman, 1st- and 2d-loaders remove the sections of the charge from the gun. The ammunition-car is brought up, the charge placed in it, and sent below to be returned to the magazine [63, (2)].

(5) The plugman, 1st- and 2d-loaders engage the shell-extractor in the cannelure at the base of the shell, start the shell from its seat, using the spider and screw, if necessary; draw the shell to the rear until the rotating-band is just clear of the chamber and projecting into the screw-box, then put in the loading-tray so that its inner lip is under the base of the shell, bring up the ammunition-car, draw the shell into it, and send it below [127].

(6) Should the shell-extractor fail to work, the shell may be rammed out from the muzzle, using a large spar or strong-back; a block of hard wood of nearly the diameter of the bore with a circular iron-plate, or bands, on the ends, to prevent its being split by the point of the shell, or blows of the spar, should be put in the bore between the shell and the spar. A large swab or pad of old canvas, should be put in the chamber in front of the mushroom-face, and the breech closed. The shell may then be rammed to the rear, the breech opened, and the shell hauled out into the ammunition-car [127, 128].

(7) Using percussion firing, or in case of a miss-fire, should it become necessary to unload, see Articles 3, (4); 11, (3); 101; 105.

Change Stations!

[19]

206. (1) To be used occasionally at drill to familiarize the men with all duties of the turret, and to show them that every duty requires skill and care to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(2) At the command, each man goes up one station, except the plugman, who becomes messenger.

Secure!

[64]

207. (1) The turret will be trained for putting in the tompions and putting on muzzle-bags; then it will be placed in the securing position for sea or port. The rammerman then locks the turret before the current or power is cut off the training-motors [121].

(2) The members of the crew return what they provided and secure what they cast loose.

(3) After actual firing, the members of the crew will assist the gunner's-mate to wash out, clean, dry and oil the bore [136].

(4) Gun-captains report to the turret-officer when their respective guns are secure.

(5) The members of the crew leave the turret and handling-room and go to their quarters for muster, when ordered by the turret-officer [Part I, 39, (2)].

(6) The gunner's-mates will inform the engine-room and dynamo-room when they have finished with the hydraulic pressure and electric current.

AMMUNITION-CREW.

[35, 36]

208. A junior-officer or a petty-officer in charge.

(30 men and a gunner's-mate. Gunner's-mate in charge of ammunition.)

NOTE.—Numbers are necessary for the handling-room crews, owing to the necessary similarity of the stations and titles of the men [14, (1), (2)].

For Each Gun.

No.	Title.	Station.
1.	Shellman.	Shell-room.
2.	"	"
3.	"	Handle shell in handling-room.
4.	"	"
5.	"	"
6.	"	Handling-room truck.
7.	Powderman.	Magazine and passage.
8.	"	"
9.	"	"
10.	"	"
11.	"	Handle powder in handling-room.
12.	"	"
13.	"	"
14.	"	"
15.	Messenger.	Communications.

Stations and Duties.

209. (1) The gunner's-mate procures the magazine and shell-room keys, unlocks the doors, sees magazine and shell-room flood-cocks clear, sees ventilating louvres open. He shall not permit any person to enter magazine wearing any other than magazine shoes, while powder is being handled outside of the tanks; supervises handling of ammunition.

(2) 1 and 2 ship shell-tongs and start shell through the door.

- (3) 3, 4, 5, and 6 ship overhead tracks, receive shell from 1 and 2, land it on turn-table and shove it into the car.
(4) 3, leading man of outside shell-group.
(5) 6 operates the handling-room truck.
(6) 7, 8, 9, 10, inside magazine, open tanks, pass sections of powder through door as necessary.
(7) 7, leading man of inside powder-group.

NOTE.—No more powder will be passed into the handling-room than is necessary to load the cars, and the magazine doors will habitually be kept closed, the powder being passed through the opening in the door provided for that purpose, and the flaps of the opening kept closed except when it is opened for the powder to be passed out, or for necessary communications.

- (8) 11, 12, 13, and 14, in handling-rooms, connect fire-hose; receive sections of charge from magazine and place them in the ammunition-car, being particularly careful to see that the tie-end of every section is towards the muzzle of the gun [34, (3)].

(9) 11, leading man of outside powder-group.

- (10) 15 (Right) provides drinking-water for ammunition-crew; at voice-pipe or other communications with turret; repeats all messages received to the officer or petty-officer in charge of the ammunition-crew; signals to turret when each car is ready for hoisting [141].

- (11) 15 (Left) at voice-pipe in magazine passage communicating with central station; repeats all messages received to the officer or petty-officer in charge of the ammunition-crew.

NOTE.—Large and efficient ammunition-crews are essential for providing an ample supply of ammunition for the guns. They also form the turret reserve, and should be drilled at the guns in order to be qualified to fill vacancies in the turret. The senior man in each ammunition-crew will act as captain of that crew.

DRILL FOR 12-INCH TURRETS. U. S. S. TEXAS.

12-inch Mark I gun on Mark II mount. (Hydraulic.)

NOTE.—Attention is especially invited to Notes on Turret Mounts, Arts. 113 to 132, and 142 to 161.

STATIONS.

[14]

210. (1) **Turret-officer and turret-captain** in the rear of the gun in the most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) **The gun-pointer group** consists of a 1st- and 2d-pointer and a sight-setter for each hood. These men take their stations in the pointing- and training-hoods. The 1st- and 2d-pointers alternate at pointing and training, each performing these operations from his own hood, and the sight-setters set the two sights [28, 54, 56, 57, 93, 94, 95].

(3) **Gun-crew.**

Title.	Station.
--------	----------

Plugman.	At plug-crank.
Trayman.	Opposite plugman.
Loader.	In rear of plugman.
Hoistman.	At lever of ammunition-hoist.
Rammerman.	At rammer-lever.
Pawlman.	At loading-pawl lever.
Motorman.	At gun-working motor-lever.
Messenger.	At telephone and annunciator.

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the turret-officer, if necessary.)

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence and, as far as practicable, without commands.

Cast Loose and Provide!

[20 to 32]

211. (1) Before entering the turret, all the regular gun-crew clear away the rail. The messenger removes tompion, slacks up apron turn-buckles and removes turret hatch-cover [122].

(2) **Turret-captain** commands; prepares firing-lock for use [97]; opens exhaust and pressure-valves on training-motors; opens

elevating-motor valves; and opens main pressure-valve inside of turret, when pressure is reported ready by engineer's division from redoubt.

(3) **1st-pointer** sees pointing-hood clear; removes cover from sights; turns on sight-lights; places gun in loading position as soon as pressure is on turret; takes station in pointing-hood.

(4) **2d-pointer** sees training-hood clear, removes cover from sights; turns on sight-lights, and trains gun abeam as soon as unlocked; takes station in training-hood.

(5) **The sight-setters** examine and see secure the firing-terminals [96] at the battery-box; unlock turret as soon as main pressure-valve is open; take station as sight-setters in pointing- and training-hood.

(6) **The plugman** opens breech-plug; examines gas-check pad [108, (10)], firing-lock, attachment-lug and firing-attachments on breech-plug [27; 29; 51, (9)]; sees bucket of water with marine-sponge at hand [48, (2)]; also sees a spare lock, a hand-extractor, priming-wire, boring-bit and vent-cleaner at hand and ready for use [26].

(7) **The trayman** sees loading-tray at hand [39]; fills primer-rack; sees firing-attachment secure to lug on rear face of breech, and that lug is clean; looks through breech and reports "Bore clear" [32].

(8) **The loader** sees hand-rammer in place; opens rammer-valve No. 1, and hoist-valve.

(9) **The hoistman** hoists and lowers ammunition-car as soon as breech-plug is open, so as to drain all water out of hoist-motor [113, (8)].

(10) **The rammerman** opens rammer-valve and runs rammer out and in once, to see if in good working order.

(11) **The pawlman** places pawl in loading position as soon as gun is lifted from securing position.

(12) **The motorman** sees gun-working-motor valves open; runs rods out and then in, to see if in good working order. These rods should always be left run in *with pressure on*, to insure their not running out.

(13) **The messenger** connects up speaking-tubes in turret; opens telephone.

Load!

NOTE.—To exercise the crew at loading, the gun should habitually be run in and off the pawl, so as to be in the exact position that it would be in immediately after firing. To run the gun in, lift the holding-out pawls, depress the breech, and the gun will come in by gravity.

212. (1) First, and simultaneously:

- (a) *The pawlman* places pawl in loading position.
- (b) *Pointer* places gun on loading-pawl. The motorman runs gun out to battery.
- (c) *The plugman* opens breech-plug.
- (d) *The loader and rammerman* turn down rammer.
- (e) *The trayman* holds loading-tray and inserts it as soon as plug swings open [39]; inspects bore and when clear reports "Bore clear" [32].

(2) Second, and simultaneously:

- (a) *The plugman* extracts primer and wipes off mushroom-head.
- (b) *The hoistman* brings up ammunition-car.
- (c) *The motorman* runs in gun-working-motor rods.

(3) Third, and simultaneously:

- (a) *The rammerman* rams shell home, opens rammer-exhaust and picks up hand-rammer [33; 118, (1)].
- (b) *The motorman* lowers loader's-platform.
- (c) *The trayman* and hoistman lift out rear powder-bags and hold them in readiness for the loader.

(4) Fourth: *The loader* shoves in two powder-bags at once [34, (2)], assisted by hoistman and rammerman, and then puts in the third bag, after which the three sections are pushed in by the hand-rammer, and then the fourth bag of the charge is put in by hand, and placed so as to touch the mushroom-head when the breech is closed.

(5) Fifth, and simultaneously:

- (a) *The motorman* raises loader's-platform.
- (b) *Trayman* unlocks car.
- (c) *Hoistman* lowers car.

(6) Sixth, and simultaneously:

- (a) *Pointer* takes gun off loading-pawl and picks up target.
- (b) *Trayman* removes loading-tray [39].
- (c) *Plugman* closes breech-plug.
- (d) *Loader and rammerman* turn up rammer.

(7) Seventh: *The trayman* inserts [51, (16); 105, (3)] and calls "Ready," or touches pointer on leg.

NOTE.—The above is for the starboard turret, in which the breech-plug swings open to the right. For the port turret, in which the breech-plug swings to the left, it is inconvenient for the trayman to insert the primer, as he would have to do it with his left hand. Consequently, in this turret either the captain or the loader may be trained to prime.

(8) Immediately on the firing of the gun, the same process is gone through unless the command **CEASE FIRING!** is given.

NOTE.—COMMENCE FIRING! CEASE FIRING! UNLOAD! and SECURE! are the same as in other turret gun-drills.

AMMUNITION-CREW.

[35, 36]

213. A junior-officer or a petty-officer in charge. Gunner's-mate in charge of ammunition.

No.	Title.	Station.
1.	Shellman.	In shell-room.
2.	"	"
3.	"	"
4.	"	"
5.	Powderman.	In magazines.
6.	"	"
7.	"	"
8.	"	"
9.	Hoistman.	At hoist-lever in redoubt.
10.	Shellman.	At top of hoist in redoubt.
11.	"	At differential pulley in redoubt.
12.	"	"
13.	"	At shell-car in redoubt.
14.	"	"
15.	Powderman.	At top of hoist in redoubt.
16.	"	"
17.	"	In redoubt.
18.	"	"
19.	Shellman.	On turret-floor.
20.	Powderman.	"

Stations and Duties.

214. (1) The gunner's-mate [109] procures the magazine and shell-room keys; unlocks the doors; sees the magazine and shell-room flood-cocks clear; sees ventilating louvres open. He shall not permit any person to enter magazine wearing any other than magazine shoes, while powder is being handled outside of the tanks; supervises handling of ammunition and may act as the petty-officer in charge of handling-room crew [214, (12, c)].

(2) 1, 2, 3, and 4 go immediately to shell-room and place shell on car, getting others ready to send up as soon as car comes down again.

(3) 5, 6, 7, and 8 go to magazine and place two tanks on car, getting others ready to send up as soon as pressure is turned on [34, (3)].

(4) 9 lowers car as soon as pressure is turned on.

(5) 10 and 11 get differential pulley and shell-tongs ready for use.

(6) 12 and 13 get shell-car ready for use.

(7) 14 to 20 come up all securing turn-buckles in redoubt and see everything clear for turning.

(8) As soon as the car is loaded, 9 brings it up to redoubt floor; 15 lifts off powder-tanks and passes them to 16; 9 and 10 roll shell off car onto turret-floor, and 9 immediately sends car down where it is reloaded at once.

(9) 11 places shell-tongs on shell, 12 hooks on pulley, and both hoist shell to height of car; 13 and 14 assist in landing shell on car and then take car to turret-opening, shoving shell into turret, and taking car back for the next shell. At the same time 17 opens powder-tanks and 18 takes powder to turret-opening.

(10) 19 and 20 receive shell and powder from 13, 14, and 18, and place them on turret ammunition-car.

(11) The same process is repeated until there is a load on the car, a shell in the turret in rear of the car, a shell on the car, one triced up ready to place on the car, and several shells on the turret-floor. There should be no powder out of the tanks, except the charge on the car, but 17 must always be prepared to get a charge ready as soon as the gun is loaded.

(12) The chain being formed as above, then, as soon as the car comes to the turret-floor after loading the gun, each shell and powder charge is immediately moved up to the place just occupied by the one ahead of it.

NOTE.—(a) Powder-bags should be carefully overhauled before firing is commenced. The attachment-lug on the breech-plug must be frequently examined to see that it is not bent from being struck by plug-crank when opening the breech. Although Haeseler-valves are fitted for elevating, the separate pressure- and exhaust-valves have been used to a considerable extent, the pressure-valve being opened to a point where the pointer can elevate or depress the gun by merely opening or closing the exhaust-valve.

(b) In smooth water the Haeseler-valves are probably better, but in a seaway they will not permit of a sufficiently rapid movement for continuous-aim.

(c) It is best to have a competent man in charge of the ammunition-crew. He must be well instructed and in complete control outside the turret.

(d) It is necessary to use the redoubt as a handling-room both for facility and safety; and only one charge is allowed open at a time, under any circumstances.

DRILL FOR 8-INCH TURRETS. INDIANA CLASS.

8-inch gun Mark IV mounted on Mark VII mounts. Steam-trained turret with single ammunition-hoist for the pair of guns.

NOTE.—Attention is invited to **Notes on Turret Mounts**, Arts. 113 to 143.

STATIONS.

215. (1) **Turret-officer and turret-captain** in most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) **Gun-pointer group** consists of two men for each gun-pointer station; called 1st- and 2d-pointers. The 1st- and 2d-pointers alternate at pointing and sight-setting [28, 54, 56, 57, 93, 94, 95].

(3)	Gun-crew.
-----	------------------

Title.	Station.
--------	----------

Plugman.	At plug-crank.
1st-loader.	Opposite and outboard of breech.
2d-loader.	Opposite and inboard of breech.
Hoistman (Right).	At hoist-controller.
Powderman (Left).	Below shell-table between guns.
3d-loader.	Outside of turret, handles rammer.
Gunner's-mate (one for turret).	Wherever needed.

Notes.

216. (1) Owing to this type of turret having but one hoist, and for the sake of having an equal number of men in each crew, the right crew will contain the turret-hoistman, and the left crew, the turret-powderman.

(2) One member of each gun-crew shall be detailed as gun-captain, and shall be stationed with special reference to his overseeing the working of the crew. (Part I, Art. 64.)

(3) The plugman, 1st- and 2d-loaders must be strong, active men. The hoistman, powderman, and 3d-loader should be intelligent, careful men; great strength is not required [116, (7)].

(4) The gunner's-mate will be detailed for the care of the guns and turret, and if necessary a man, preferably from the gun-pointer group, will be detailed to assist him [116, (1), (4), (5), (6)].

COMMANDS.**[15, 16, 17, 18, 19]**

(To be given by the turret-officer, if necessary.)

217. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction and range, also the setting of the sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

NOTE.—Very few commands should be necessary. The firing of the gun is the signal to prepare at once the gun for another discharge. The crew should be trained to work in silence, and, as much as possible, without commands.

Stations!

(2) At this command, which may be given at any time, the crew take their stations at the gun, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained. The crew stand in their tracks and await orders.

Cast Loose and Provide!**[20 to 32]**

(Guns secured for sea or port.)

218. (1) If the port-bucklers are shipped the members of the crew remove them before performing their other duties, the pointers and plugman working on the inside and the other members of the crew working on the outside. The turret-apron or water-shed will be raised clear of the barbette, and the turn-buckles or wedges removed [122]. As soon as the turret can be trained, it should be placed in the most convenient position for removing the port-bucklers and tompions. As soon as the port-bucklers and tompions are removed, the gun-pointers will lay the guns in the loading position.

(2) **The turret-officer**, or turret-captain, assures himself that everything is clear outside of the turret before allowing it to be trained.

(3) **The 1st- and 2d-pointers** take the plugs out of the peep-holes and sight-holes in the sighting-hoods, take caps off telescopes, inspect sights and sight-mounts, connect electric firing-wires to battery and ground-terminals [96]; test firing-circuits

[21]; turn on sight-lights; test elevating- and training-gear; lay the turret and guns for the removal of the port-bucklers and tompons, and then put the guns in the loading position; report anything out of order to the turret-officer; take their stations in the pointing- and training-hoods.

(4) **Gun-captain** reports to turret-officer when his gun is cast loose and is ready in all respects for loading.

(5) **Plugman** opens the breech and inspects the gas-check and the breech-mechanism; sees that the electric firing-wires are properly and securely connected to breech-terminal, plug-terminal, and lock-terminal [96]; inspects the lock and tries it to make sure that it is in working order [97]; sees priming-wire and boring-bit in place and ready for use [26]; provides himself with a hand primer-extractor; tends the locks on his side of the turret; takes station at plug-crank; reports anything not in working order to the gun-captain.

(6) **1st-loader** inspects the loading-tray and places it convenient for use [39]; sees bristle- and marine-sponges ready for use [26]; sees lock-lanyard at hand ready for use (it will not be hooked until just before lock is cocked to fire); examines the bore, making sure that it is clear and reports "Bore clear" [32]; provides himself with primers [21, (2)]; takes station in rear and outboard of breech; reports anything not in working order to the gun-captain.

(7) **2d-loader** passes rammer out of turret to 3d-loader; provides the gun-tub, fills it with fresh water, and places in it two marine-sponges [31, (7,c); 48, (2)], which are provided by the 1st-loader; takes station inboard to the rear of the breech, by the shell-table; sees air-blast in working order and ready for use; reports anything not in working order to the gun-captain.

(8) **Hoistman** (belongs to right gun-crew) closes hoist-motor switch; tests the hoist making sure that the current is on; hoists the car when it is ready [113, (8)]; takes station at the hoist-controller; reports anything not in working order to the gun-captain.

(9) **Powderman** (belongs to left gun-crew) assists 2d-loader to provide water for gun-tub; takes station under the shell-table, ready to handle powder.

(10) **3d-loader** receives the rammer from 2d-loader; takes out the tompon [22]; takes station outside of the turret, with the rammer in his hands.

(11) **The gunner's-mate** sees that the steam pressure is turned

on the turret and the electric current on the hoist-motors; turns on the lights in the turret, if necessary; provides locks, primers, and electric firing-wires; takes station with the turret-officer, to assist in overcoming any hitch or accident. The gunner's-mate will keep in the turret, in racks or in a locker, the articles enumerated in Notes, Article 109.

Load!

[32 to 40, 47, 48, 49, 51]

(The gun having been fired.)

219. (1) **The 1st-pointer** at once takes up the training of the turret for the firing of the opposite gun.

(2) **2d-pointer** lays the gun in the loading position, keeps the sight set as ordered.

(3) **The plugman** opens the breech while the gun is being brought to the last loading position; takes out the fired primer [51, (16)]; examines the electric firing-connections, lock, and gas-check [108, (10)]; clears the vent, if necessary [30; 51, (19)].

(4) **The 2d-loader** opens air-blast, closes it when breech is clear.

(5) **1st-loader** enters the loading-tray [39] as soon as possible; when bore is clear reports "Bore clear" [32]; receives the rammer from 3d-loader.

NOTE.—When firing with both guns with the present powder, which leaves a combustible gaseous residuum, the breech of the gun will not be opened if powder is exposed in the operation of loading the other gun. This note does not apply in the case of guns fitted with thoroughly tested and officially approved appliances for expelling combustible gases from the bore.

(6) **The 2d-loader**, as soon as the loading-tray is in the gun, swings the shell on its bearer in front of the breech, and assists the 1st-loader to ram it home [33; 118, (1)]; then swings the bearer back against the shell-table and rolls another shell onto it.

(7) **The 1st-loader** passes the rammer out to the 3d-loader, receives the sections of the charge from the powderman, and places them in the gun, tie first, being careful that the rear end of the last section is just clear of the screw-box, in proper position to take against the face of the mushroom-head, with ignition charge in front of vent [2, (6), (7); 34; 123]; removes the loading-tray; wipes out the gas-check seat [108, (10)] and screw-box with a marine-sponge, if necessary [48, (1)].

(8) **The plugman** closes the breech, stopping just before electric

connection is made, to allow 1st-loader to insert the primer; then fully closes breech [61]; unships crank if necessary [114].

(9) **The 1st-loader** stands ready with the primer, when breech is nearly closed [61], signals to the plugman to stop, inserts primer, closes lock, stands clear, and signals to plugman to close the breech.

(10) **When the gun is ready to be fired** and everyone is clear of the recoil, the plugman taps the pointer on the leg with his hand, as a signal that the gun is ready to be fired.

NOTE.—When using percussion mechanism, the plugman closes breech entirely. The 1st-loader inserts primer, hooks lanyard, cocks lock and stands clear [2, (2)].

(11) **The hoistman** keeps a full supply of shell on the shell-table, sending down the ammunition-car as necessary, and taking care not to move the car until signalled from below that it is ready.

(12) **The powderman** takes sections of charge out of car and passes them to the 1st-loader as required.

Commence Firing!

[52 to 60]

220. (1) **The 1st-pointer of one gun** points and fires the gun, aiming as directed by the turret-officer [38, 57].

(2) **The 1st-pointer of the other gun** of the pair trains the turret, keeping it trained on the target until the gun is fired. Then takes up the pointing for his own gun, and so on alternately training and firing, as it is not possible to fire the guns independently [38, 57].

(3) **The 2d-pointers** set the sights as directed, and stand by to relieve the 1st-pointers when they become fatigued.

(4) The loading and firing continue, the guns firing alternately, without commands, unless necessary, until the command **CEASE FIRING!**

(5) When exercising without powder, the gun-pointer should fire a primer, or call out **FIRE!** in order that the exercise may be continued.

NOTE.—Electric firing is so much better than percussion that it should always be used, if possible [53]. The percussion lanyard should be so led that the gun can be fired by the pointer, if percussion firing must be used. Care should be taken in arranging this lead that the lanyard is as little in the way as possible. The lock-lanyard will never be hooked except when plug is closed and locked and just before it is cocked.

Cease Firing!**[60, 61, 62]**

221. (1) The service of the gun ceases at this command.

(2) **The plugman** revolves crank just enough to break firing-circuit at attachment-lug [61].

(3) **The 1st-loader** extracts primer [2, (5); 105].

Unload!**[63]**

222. (1) **The pointer** lays the gun in the loading position.

(2) **The plugman** opens the breech just enough to break the electric connection [61], and, after the primer has been extracted, fully opens it; closes breech after gun is unloaded.

(3) **The 1st-loader** extracts the primer [3, (3), (4)], standing clear of the breech while doing so, and using great care to avoid firing it.

(4) **After the breech has been opened;** the 1st- and 2d-loaders remove the sections of the charge from the gun. The car is brought up, the charge placed in it, and sent below to be returned to the magazine [63, (2)].

(5) **The plugman, 1st- and 2d-loaders** engage the shell-extractor in the cannelure at the base of the shell, start the shell from its seat, using the spider and screw, if necessary; draw the shell to the rear until the rotating-band is just clear of the chamber and projecting into the screw-box; then put in the loading-tray so that its inner lip is under the base of the shell; swing down the empty shell-bearer; haul the shell onto it; swing it up to the table; put the shell in the car, and send it below [127; 128; 181, (6)].

(6) **Using percussion firing,** should it become necessary to unload, see Articles 3, (4); 11, (3); 101; 105.

(7) **After a miss-fire** the gun will not be unloaded, nor the breech opened within 20 minutes from the last trial. [See note on miss-fires, Articles 98 to 104.]

NOTE.—A miss-fire in this sense means that the primer has fired and the gun has failed to go off.

Change Stations!**[19]**

223. (1) **To be used occasionally at drill** to familiarize the men with all the duties of the turret, and to show them that every duty

requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(2) At this command every man goes up one station, except the plugman, who becomes 3d-loader.

Secure!

[64]

224. (1) The turret will be trained for putting in the tompions and putting on muzzle-bags; then it will be placed in the securing position for sea or port. The rammerman then locks the turret before the steam is cut off the training-gear [121].

(2) The members of the crew return what they provided and secure what they cast loose.

(3) After actual firing, the members of the crew will assist the gunner's-mates to wash out, clean, dry, and oil the bore [130].

(4) Gun-captains report to the turret-officer when their respective guns are secure.

(5) The members of the crew leave the turret and go to their quarters for muster, when ordered by the turret-officer [Part I, 39, (2)].

DRILL FOR 8-INCH SUPERIMPOSED TURRETS. KEARSARGE AND KENTUCKY.

Electric train, Mark IV guns on Mark IX mounts.

NOTE.—Attention is invited to Notes on Turret Mounts, Arts. 113 to 142.

STATIONS.

225. (1) Turret-officer in most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) The gun-pointer group consists of two men for each gun-pointer station, called 1st- and 2d-pointer. The 1st- and 2d-pointers to alternate at pointing and sight-setting [28, 54, 56, 57, 93, 94, 95].

(3) Gun-crew.

Title.	Station.
Plugman.	At plug-crank.
1st-loader.	Rear and outboard of breech.
2d-loader.	Rear and inboard of breech.
Hoistman.	At hoist-controller.
Messenger.	Communications.
Gunner's-mate (one for turret).	Wherever needed.

Notes.

226. (1) One member of each gun-crew shall be detailed as gun-captain, and shall be stationed with special reference to his overseeing the working of the crew. (Part I, Art. 64.)

(2) The plugman, hoistman, and messenger must be intelligent, careful men. Great strength is not required. The 1st- and 2d-loaders must be large, strong, active men [116, (7)].

(3) One gunner's-mate must be detailed for the care of the guns, turret and handling-room. To assist him in the care of the guns and turret, one man should be detailed from the turret-crew; to assist him in the care of the handling-room, one man should be detailed from the handling-room crew [116, (1), (4), (5), (6)].

COMMANDS.**[15, 16, 17, 18, 19]**

(To be given by the turret-officer, if necessary.)

227. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and the setting of the sight for lateral compensation); **COMMENCE FIRING!** **CEASE FIRING!** **UNLOAD!** **SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

Stations!

(2) At this command, which may be given at any time, every member of the crew will take his proper station at the gun, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained; the men stand in their tracks and await orders.

Cast Loose and Provide!**[20 to 32]**

(Guns secured for sea or port.)

228. (1) If the port-bucklers are shipped, the members of the crew remove them before performing their other duties. The plugman and 1st-loader working inside; the 2d-loader, hoistman, and messenger working outside. As soon as the port-bucklers are removed, the gun-pointers will lay the guns in loading position.

(2) **1st-pointers** take the plugs out of the peep-holes and sight-holes in the sighting-hoods; take caps off of telescopes; inspect sights and sight-mounts; connect electric firing-wires to battery and ground-terminals [96]; and test firing-circuit [21]; turn on sight-lights; test elevating-gear to make sure that everything is in working order; put the guns in the loading position; report anything out of order to the turret-officer; take their stations in the hoods.

(3) **2d-pointers** assist 1st-pointers in connecting up firing-circuit, if necessary; take stations to set sights as directed.

(4) **The gun-captain** reports to turret-officer, when his gun is cast loose and ready in all respects for loading.

(5) **Plugman** opens breech and inspects gas-check [108, (10)] and breech-mechanism [27; 29; 51, (9)]; sees that the electric

firing-wires are properly and securely connected to breech-terminal, plug-terminal and lock-terminal; inspects the lock and tries it to make sure that it is in working order [97]; sees priming-wire, boring-bit and vent-cleaner in place and ready for use [26]; provides himself with a hand primer-extractor; takes station at plug-crank; reports anything not in working order to the gun-captain [114].

(6) **1st-loader** provides loading-tray [39] and places it convenient for use; provides rammer; sees bristle- and marine-sponges ready for use [26, (2); 31, (4)]; sees lock-lanyard ready for use [26]; examines the bore, making sure that it is clear and reports "Bore clear" [32]; provides himself with primers [21, (2)]; takes station outboard of and in rear of breech; reports anything not in working order to the gun-captain.

(7) **2d-loader**, assisted by messenger, fills gun-tub with fresh water [31, (7, c); 48, (2)]; provides two marine-sponges for gun-tub; tests air-blast, if fitted, and sees it in working order; takes station in rear and inboard of breech.

(8) **Hoistman** removes muzzle-bag and tompion [22]; tests hoist-controller; closes hoist-switch and circuit-breaker; sees that current is on and tests hoist and brake, after warning handling-room [113, (8)]; takes station at hoist-controller and brake; reports anything not in working order to the gun-captain.

(9) **Messenger** assists 2d-loader to fill gun-tub with fresh water; takes station where directed, and reports to turret-officer all messages, ranges, etc., which he receives.

(10) **The gunner's-mate** takes station near turret-officer; ready to assist in overcoming any difficulties. The gunner's-mate will keep in the turret, ready for use, in racks or in a locker, the articles enumerated in Notes, Art. 109.

Load!

[32 to 40, 47, 48, 49, 51]

(The gun having been fired.)

229. (1) **1st-pointer** lays gun in loading position, the 2d-pointer warning him to do so.

(2) **The plugman** opens the breech while the gun is being brought to the loading position (See note below, on precautions to be taken when firing both guns); extracts fired primer in case it has not been done; examines electric firing-connections, lock and gas-check [108, (10)]; clears vent, if necessary [30; 51, (19)];

wipes off mushroom with marine-sponge [48]; feels of mushroom-head and, if hot, reports to turret-officer.

NOTE.—When firing both guns with the present powder, which leaves a combustible gaseous residuum, the breech of the gun fired will not be opened if powder is exposed in the operation of loading the other gun. This note does not apply in the case of guns fitted with a thoroughly tested and officially approved appliance for expelling the combustible gases from the bore.

(3) **1st-loader** extracts fired primer while breech is being opened; enters the loading-tray [39] as soon as possible; examines bore and chamber and reports when they are clear [51, (10)].

(4) **2d-loader** opens air-blast, if fitted; closes it when bore is clear.

(5) **The hoistman**, as soon as the car is loaded and bore of gun is clear, brings up car until pawl catches; slacks up hoist enough for car to be pulled over to loading position [4, (1)].

(6) **1st-loader** takes out pin that holds the projectile in the car as it comes up; pulls car down to loading position; pushes the shell clear of car into the gun and signals to hoistman when it is clear [107].

(7) **2d-loader** takes powder out of car as soon as it comes up, and lays it on turret-floor.

(8) **Hoistman**, upon signal from 1st-loader, hoists car to vertical position and clear of pawl, then lowers it to handling-room [113, (8)].

(9) **1st-loader** replaces shell-pin and 2d-loader holds up pawl until car is clear. 1st-loader, assisted by 2d-loader, rams shell home smartly, withdraws rammer [33; 118, (1)].

(10) **2d-loader** picks up the two sections of powder and hands them to 1st-loader, who puts them in the gun, seeing rear end of charge in proper position to take against the face of mushroom-head with ignition charge in front of vent [51, (11)]; removes loading-tray; if necessary, wipes out gas-check seat and screw-box with marine-sponge [48, (1)].

(11) **Plugman** closes the breech, stopping just before electric connection is made to allow 1st-loader to insert primer [61].

(12) **The 1st-loader** stands ready with primer [2, (1)]; when breech is nearly closed, signals to plugman to stop [61]; inserts primer, closes lock, stands clear and signals to plugman to close breech completely.

NOTE.—If percussion firing is being used, the plugman closes the breech entirely; 1st-loader then inserts primer, hooks lock-lanyard, cocks lock and stands clear,

(13) When the gun is ready to be fired and everyone is clear of the recoil, the plugman fully closes the breech and taps the pointer on the leg as a signal that the gun is ready to be fired.

Commence Firing!

[52 to 60]

230 (1) The pointer points and fires the gun, aiming as directed [38, 57].

(2) The pointer not pointing sets pointers-sight as directed [38, 57].

(3) The 1st- and 2d-pointers stand by to relieve each other.

(4) The loading and firing continue without commands, unless necessary, until the command CEASE FIRING!

(5) When exercising without powder, the gun-pointer should fire a primer, or call out FIRE! in order that the exercise may be continued [21].

NOTE.—Electric firing is so much better than percussion that it should always be used if possible [58]. The percussion lock-lanyard should be led so that the gun can be fired by the pointer if percussion firing must be used. Care should be taken in arranging this lead that the lanyard is as little in the way as possible, and not liable to be fouled. The lock-lanyard will never be hooked except when plug is closed and locked.

Cease Firing!

[60, 61, 62]

231. (1) The plugman turns plug-crank back just enough to break electric firing-connection at breech-terminal [61].

(2) The 1st-loader carefully extracts primer [2, (5); 105].

(3) Should the command COMMENCE FIRING! again be given, the gun will be primed as under LOAD! [51, (7), (8)].

Unload!

[63]

232. (1) The pointer lays the gun in loading position.

(2) The plugman turns the plug-crank back just enough to break the electric firing-connection at breech-terminal [61], and after the primer has been extracted, fully opens the breech; closes breech after gun is unloaded.

(3) The 1st-loader extracts the primer [3, (3), (4)], standing clear of the breech while doing so and using great care to avoid firing it [105, 106].

(4) After the breech has been opened, 1st-loader and 2-loader remove the sections of the charge from the gun; the ammunition-

car is brought up, the charge placed in it, and sent below to be returned to the magazine [63, (2)].

(5) **The plugman, 1st- and 2d-loader** engage the shell-extractor in the cannelure at the base of the shell; start the shell from its seat, using the spider and screw, if necessary; draw the shell to the rear until the rotating-band is just clear of the chamber and projecting into the screw-box; put in the loading-tray so that its inner lip is under the base of the shell; bring up the ammunition-car; haul the shell into it and send it below [127, 128].

(6) **Should the shell-extractor fail to work**, the shell may be rammed out from the muzzle, using the sectional rammer and striking the shell a sharp blow with it. A swab, or pad of old canvas, should be put in the chamber in front of the mushroom-face and *the breech closed*. The shell may then be rammed to the rear, the breech opened and the shell hauled out into the ammunition-car [127, 128].

(7) Using percussion firing, or in case of miss-fire, should it become necessary to unload, see Articles 3, (4); 11, (3); 101; 105.

Change Stations!

[19]

233. (1) **To be used occasionally at drill** to familiarize the men with all the duties of the turret and to show them that every duty requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(2) At the command, every man goes up one station except the plugman, who becomes messenger.

Secure!

[64]

234. (1) The members of the crew return what they provided and secure what they cast loose.

(2) After actual firing, the members of the crew will assist the gunner's-mates to wash out, clean, dry and oil the bore [130].

(3) Gun-captains report to the turret-officer when their respective guns are secure.

(4) The members of the crew leave the turret and handling-room and go to their quarters for muster, when ordered by the turret-officer [Part I, 39, (2)].

AMMUNITION-CREW.

[35, 36]

235. A petty-officer in charge. (20 men.)

NOTE.—Numbers are necessary for the handling-room crews, owing to the necessary similarity of the stations and titles of the men.

For each gun.

No.	Title.	Station.
1.	Shellman.	In shell-room.
2.	"	At trolley.
3.	"	"
4.	"	Tends switch; at truck.
5.	"	At truck.
6.	"	"
7.	Powderman.	At powder-whip.
8.	"	"
9.	"	In magazine.
10.	"	"

Stations and Duties.

236. (1) The gunner's-mate of the 13-inch handling-room also provides keys of 8-inch magazines and shell-rooms.

(2) 1, in shell-room, always keeping a pair of shell-tongs on a shell ready to be taken by trolley.

(3) 2 and 3 hoist shell, take it out into handling-room and land it on truck.

(4) 4 tends switch, assists at truck, tending pins of car.

(5) 5 and 6, at truck, receive shell and shove it into car, tend signal-light and voice-pipe, report all messages received, to petty-officer in charge [141].

(6) 7 and 8 man powder-whip; take powder out of tank, put it in car.

(7) 9 and 10, in powder-magazines, hook on powder-tanks.

NOTE.—The 8-inch ammunition-crews and gun-crews should belong to the same division as the crews of the 13-inch turret on which it is superimposed. This division should have two commissioned officers. No one is required from the powder-division. Large and efficient ammunition-crews are essential for providing an ample supply of ammunition for the gun. They also form the turret-reserve and should be drilled at the gun in order to be qualified to fill vacancies in the turret. The senior man in each ammunition-crew shall act as captain of that crew.

DRILL FOR 8-INCH TURRETS. IOWA AND BROOKLYN.

Steam train, hand elevation, electric ammunition-hoist.

Mark IV guns, Mark VIII mounts.

NOTE.—Attention is invited to Notes on Turret Mounts, Arts. 113 to 142.

STATIONS.

[14]

237. (1) **The turret-officer** and the **turret-captain** in the most advantageous position for superintending the working of the guns [161, (1), (2), (3), (4), (5)].

(2) **The gun-pointer group** consists of two men for each gun-pointer station, called 1st- and 2d-pointers. The two pointers firing shall alternately train and point, each pointer training while the other fires. The pointers not firing act as sight-setters [28, 54, 56, 57, 93, 94, 95].

(3)

Gun-crew.

Title.

Station.

Plugman.

At plug-crank.

1st-loader.

Opposite breech, in rear of plug-man.

2d-loader.

Inboard, in rear of breech.

Hoistman.

At hoist-controller.

Messenger (right gun).

At telephone.

Messenger (left gun).

As directed by turret-officer.

Gunner's-mate (one for turret) Wherever needed.

Notes.

238. (1) One member of each gun-crew shall be detailed as gun-captain and shall be stationed with special reference to his overseeing the working of the crew (Part I, Art. 64).

(2) The plugman, hoistman and messenger must be intelligent, careful men; great strength is not required. The 1st- and 2d-loader must be large, strong, active men [116, (7)].

(3) One gunner's-mate must be detailed for the care of the guns and turret. To assist in the care of guns and turret one

man should be detailed from the turret-crew [116, (1), (4), (5), (6)].

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the turret-officer, if necessary.)

239. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and also the setting of the sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

Stations!

(2) At this command, which may be given at any time, the crew go to their stations, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained; the men stand in their tracks and await orders.

Cast Loose and Provide!

[20 to 32]

(Guns secured for sea or port.)

240. (1) If the port-bucklers are shipped, the crew will remove them before performing their other duties, the 2d-loaders, hoist-man and messenger working outside. The turret-apron or watershed will be raised clear of the barbette by those working outside [122], and the turret unlocked by the 2d-pointer. As soon as the turret can be trained, it should be placed in the most convenient position for removing the port-bucklers and tompions. As soon as the port-bucklers and tompions are removed, the gun-pointers will lay the guns in the loading position.

(2) The turret-officer, or turret-captain, will assure himself that everything is clear outside of the turret before allowing it to be trained.

(3) The 1st-pointers take the plugs out of the peep-holes and sight-holes in the sighting-hoods; take caps off telescopes; inspect sights and sight-mounts; connect electric firing-wire to battery

and ground-terminals [96], and test firing-circuit [21]; turn on sight-lights; test elevating and training-gear to make sure that everything is in working order; lay the guns for the removal of the tompions and then put the guns in the loading position; report anything out of order to the turret-officer; take station in the pointing-hoods; point or train as directed.

(4) **2d-pointers** assist the gunner's-mate in taking out locking-bolts; assist the 1st-pointers in connecting up firing-circuit, if necessary; take station to set sight as directed.

(5) **The gun-captain** reports to turret-officer when his gun is cast loose and is ready in all respects for loading.

(6) **Plugman** opens the breech and inspects gas-check [108, (10)] and breech-mechanism [27; 29; 51, (9)]; sees that the electric firing-wires are properly connected to breech-terminal, plug-terminal, and lock-terminal; inspects the lock and tries it to make sure that everything is in working order [97]; sees priming-wire, boring-bit, and vent-cleaner in place and ready for use [26]; provides himself with a hand primer-extractor; takes station at plug-crank; reports anything not in working order to gun-captain [114].

(7) **1st-loader** provides loading-tray [39] and places it convenient for use; provides rammer; sees bristle-sponge (under top of turret) and marine-sponges ready for use [26, (2); 31, (4)]; sees lock-lanyard ready for use [26]; examines the bore, making sure that it is clear, and reports "Bore clear" [32]; provides himself with primers (in primer-racks) [21, (2)]; takes station opposite breech in rear of plugman.

(8) **2d-loader**, assisted by messenger, fills gun-tub with fresh water [31, (7, c)]; provides two marine-sponges for gun-tub [48, (2)]; takes station in rear and inboard of breech; tests air-blast and sees it in working order.

(9) **Hoistman** removes muzzle-bag and tompion [22]; tests hoist-controller; closes hoist-switch; sees friction-brake in working order and that the whip is clear; tries hoist to make sure that it is in working order [113, (8)]; takes station at hoist-controller and control-brake; reports anything not in working order to gun-captain.

(10) **Messenger** assists 2d-loader to fill gun-tub with fresh water. The messenger (right) takes station at telephone and battle-order indicators; reports all messages received to turret-officer. Messenger (left) takes station where directed, and acts as turret-officer's messenger.

(11) **The gunner's-mate** telephones to engine-room to turn the steam on the turret, and to the dynamo-room to switch the current on the hoist-motors; sees that the locking-bolts are out; provides and places locks, primers and electric firing-wires if these are not already in place; takes station near the turret-officer, to assist in overcoming any difficulties. The gunner's-mate will keep in the turret ready for use, in racks or in a locker, the articles enumerated in Notes, Art. 109.

Load!

[32 to 40, 47, 48, 49, 51]

(The gun having been fired.)

241. (1) **1st-pointer** lays the gun in the loading position, the **2d-pointer** warning him to do so; takes up the training for the other gun.

(2) **Plugman** ships plug-crank (this may be left in place during firing, if well secured) [114]; opens breech while the gun is being brought to the loading position (See note below, on precautions to be taken when firing both guns); extracts fired primer (in case it has not been done); examines electric firing-connections, lock and gas-check [108, (10)]; clears vent, if necessary [30; 51, (19)]; wipes off mushroom-head with marine-sponge [48]; feels the mushroom-head, and, if hot, reports to turret-officer.

NOTE.—When firing with both guns with the present powder, which leaves a combustible gaseous residuum, the breech of the gun fired will not be opened if powder is exposed in the operation of loading the other gun. This does not apply in the case of a gun which is fitted with a thoroughly tested and officially approved appliance for expelling the combustible gases from the bore.

(3) **2d-loader** opens valve to air-blast; closes it when bore is clear [107].

(4) **1st-loader** extracts the fired primer while breech is being opened; enters the loading-tray as soon as possible [39, 40]; examines bore and chamber and reports when they are clear [51, (10)].

(5) **The hoistman**, as soon as the ammunition-car is loaded, brings it up just below the turret-floor [113, (8)], and, when the bore of the gun is clear, brings up car until pawl catches.

(6) **The 2d-loader** releases track and places car in loading position, the hoistman slackening the hoist-whip sufficiently to allow this to be done; takes powder out of car and places it on the turret-floor; replaces pins in car.

(7) **The 1st-loader** shoves the shell on to loading-tray with his

hand; 1st- and 2d-loader swing the car to vertical, the hoistman taking in the slack of the whip; the 2d-loader pulls pawl and the hoistman lowers car.

(8) Meanwhile 1st-loader stands ready with rammer, and as soon as car is clear, sends home the shell, assisted by 2d-loader. 1st-loader drops rammer [33; 118, (1)].

(9) **2d-loader** passes sections of powder to 1st-loader, who places them in the chamber, tie-end first, the first sections close against the base of the shell and the second just clear of the loading-tray [51, (16); 123]; removes loading-tray; wipes out screw-box, if necessary, with marine-sponge [34, 48], which he receives from plugman; signals plugman to close breech.

(10) **Plugman** closes breech, stopping just before the electric connection is made to allow 1st-loader to insert the primer [61].

(11) **1st-loader** stands ready with the primer [21, (2); 51, (16)]; when breech is nearly closed signals to plugman to stop [61]; inserts primer [105, (3)]; closes lock, stands clear, and signals to plugman.

(12) **When the gun is ready to be fired** and every one is clear of the recoil, the plugman fully closes the breech, unships plug-crank, if necessary (this is usually unnecessary) [114], and taps the pointer on the leg with his hand, as a signal that the gun is ready to be fired. If using percussion firing, plugman closes breech entirely; 1st-loader inserts primer, hooks lanyard, cocks lock and stands clear.

Commence Firing!

[52 to 60]

242. (1) **The pointer** points and fires the gun, aiming as directed [38, 57].

(2) After firing he will take up the training for the other gun, and so on, pointing and training alternately.

(3) **The pointers not firing or training** set the sights as directed [38].

(4) **The 1st- and 2d-pointers** stand by to relieve each other.

(5) The loading and firing continue without commands, unless necessary, until the command **CEASE FIRING!**

(6) When exercising without powder, the gun-pointer should fire a primer or call out FIRE! in order that the exercise may be continued [21].

NOTE.—Electric firing is so much better than percussion that it should always be used if possible [53]. The percussion lock-lanyard should be led so that the gun can be fired by the pointer, if percussion firing must be

used. Care should be taken in arranging this lead that the lanyard is as little in the way as possible, and not liable to be fouled; the lock-lanyard will never be hooked except when plug is closed and locked and just before lock is cocked.

Cease Firing!

[60, 61, 62]

243. (1) **The plugman** ships plug-crank and turns it back just enough to break the electric firing-connection at breech-terminal [61].

(2) **1st-loader** carefully extracts primer [2, (5); 105].

(3) Should the command COMMENCE FIRING! again be given, the gun will be primed as under LOAD! [51, (7), (8)].

Unload!

[63]

244. (1) **The pointer** lays the gun in the loading position.

(2) **The plugman** ships the crank (if unshipped) and turns it back just enough to break the electric firing-connection at breech-terminal [61], and, after the primer has been extracted, fully opens breech; closes breech after gun is unloaded.

(3) **The 1st-loader** extracts the primer [3, (3), (4)], standing clear of breech while doing so, and using great care to avoid firing it [105].

(4) After the breech has been opened 1st- and 2d-loader remove the sections of the charge from the gun. The ammunition-car is brought up, the charges placed in it, and sent below to be returned to the magazine [63, (2)].

(5) **The plugman, 1st- and 2d-loader** engage the shell-extractor in the cannelure at the base of the shell; start the shell from its seat, using the spider and screw, if necessary; draw the shell to the rear until the rotating-band is just clear of the chamber and projecting into the screw-box; then put in the loading-tray so that its inner lip is under the base of the shell; bring up the ammunition-car, haul the shell into it and send it below [127, 128].

(6) **Should the shell-extractor fail to work**, the shell may be rammed out from the muzzle, using the sectional rammer and striking the shell a sharp blow with it. A swab, or pad of old canvas, should be put in front of the mushroom-face, and the breech closed. The shell may then be rammed to the rear, the breech opened, and the shell hauled into the ammunition-car [127, 128].

(7) **Using percussion firing**, should it become necessary to un-

load, or in case of miss-fire, see Notes, Articles 3, (4); 11, (3); 101; 105.

Change Stations!

[19]

245. (1) To be used occasionally at drill to familiarize the men with all duties of the turret, and to show them that every duty requires skill and care to properly perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(2) At the command every man goes up one station, except the plugman, who goes to messenger.

Secure!

[64]

246. (1) The turret will be trained for putting in the tom-pions and putting on muzzle-bags; then it will be placed in the securing position for sea or port; the 2d-pointers then lock the turret before the steam is shut off the training-gear [121].

(2) The members of the crew return what they provided and secure what they cast loose.

(3) After actual firing, the members of the crew will assist the gunner's-mates to wash out, clean, dry, and oil the bore [130].

(4) Gun-captains report to the turret-officer when their respective guns are secure.

(5) The members of the crew leave the turret and handling-room and go to their quarters for muster, when ordered by the turret-officer [Part I, 39, (2)].

(6) The gunner's-mate will inform the engine-room and dynamo-room when he has finished with the steam-pressure and electric-current.

BROADSIDE GUNS OF THE MAIN-BATTERY.

DRILL FOR 8-INCH B. L. R. BROADSIDE MOUNT. CHICAGO TYPE.

8-inch Gun Mark IV on Mount Mark XI.

NOTE.—Attention is invited to Arts. 2, 3, 4, and 12 to 113.

STATIONS.

247.

Gun-crew.

Title.	Location.	Station.
Gun-captain (if an extra man).	Where he can best direct the crew.	
Plugman.	At plug-crank.	
Pointer.	At elevating-wheel.	
Trainer.	At training-wheel.	
Sight-setter.	At pointing-sight.	
Trayman.	At left and rear of breech.	
Loader.	In rear of breech.	
1st-Shellman.	At shell-whip.	
2d-Shellman.	At shell-whip.	
Powderman.	In rear of breech.	

Notes.

248. (1) The gun-pointer group will ordinarily consist of three men, the pointer, the trainer, and the sight-setter. The pointer and trainer shall alternately train and point, each one training while the other points and fires. The sight-setter sets the sight of the one who is firing [19, 28, 54, 56, 57, 93, 94, 95].

(2) It will usually be impracticable to assign a separate man as gun-captain. In that event one member of the gun-crew shall be detailed as gun-captain in addition to his other duties. The plugman can usually best perform this duty. Some ships assign one gun-captain to a gun and its opposite; some have one gun-captain for a group of guns. This must necessarily depend on the number of men on board available for the service. As ships will not ordinarily have a spare man for this position, the drill is written as if the plugman acted as captain of the gun-crew. (See Part I, Art. 64.)

(3) In guns whose ammunition-hoists are considerably removed from their guns an extra shellman or powderman, or both, should be assigned to the crews, in order that these guns may maintain as rapid a fire as the guns which are more favorably situated [49].

(4) The plugman, loader, and shellman should be large, strong, active men. The other members of the gun-crew should be careful, intelligent men, but great strength is not required.

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the division-officer, if necessary.)

249. (1) **CAST LOOSE AND PROVIDE! LOAD!** (designating object, direction, range, and also the setting of the sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

Stations!

(2) At this command, which may be given at any time, the crew go to their stations, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained; the men stand in their tracks and await orders.

Change Stations!

(4) This command should be used occasionally at drills to familiarize the members of the crew with all the duties to be performed at the gun, and to show them that every duty requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(5) At this command, every man below plugman goes up one station; the plugman becomes powderman. The gun-pointer group is at this command to be kept intact, except that the pointer and trainer change places.

Cast Loose and Provide!

[20 to 32]

(Gun secured for sea.)

250. (1) **The whole crew** casts off gun-lashings.

(2) **Gun-captain** commands; sees gun and mount in working order [29]; supervises all tests; sees accessories and spare parts at hand [109]; reports to officer of division when all is ready; if separate man, supervises setting of fuse when using shrapnel.

(3) **Plugman** ships lock; connects firing-attachment at lock and plug-terminal [96]; examines breech-mechanism [27; 29; 51, (9)]; provides lanyard for percussion firing; provides priming-wire [26; 51, (19)] and hand primer-extractor; examines bore and reports "Bore clear" [32].

NOTE.—Care must be taken in shipping the lock to see that it is screwed up tight and that the catch is engaged.

(4) **The primer-seat** should be wiped out clean and be free from oil [105, (3)].

(5) **Pointer** provides and connects firing-attachment; tests elevating-gear [29, (2)]; tests firing-circuit [21]; at night provides and connects battle-lantern. The firing-circuit should be tested by firing a primer [21, (1); 96, (2)].

(6) **Trainer** places training-sight; tests training-gear [29, (2)].

(7) **Sight-setter** provides all sights; places pointing-sight; at night sees electric connections for night-sights made [28, 95].

(8) **Trayman** provides loading-tray [39]; removes muzzle-bag and tompion [22], assisted by loader.

(9) **Loader** provides combination sponge and rammer [47; 107, (4)]; removes muzzle-bag and tompion, assisted by trayman [22]; provides himself with primers [21, (2)].

(10) **1st-shellman** hooks shell-whip; provides shell [24].

(11) **2d-shellman** provides shell-tongs and shell [24].

(12) **Powderman** provides gun-tub filled with fresh water, and marine-sponge [31, (4), (7, c); 48]; provides powder [24, 41].

(13) **Gunner's-mate** provides tourniquets, fine half-round file, bore- and chamber-sponges, spare parts, shell-extractor, waste, vaseline, bag of sand [109].

NOTE.—The spare parts, which would be provided only at target-practice or in action, should consist of the following: Lock, firing-attachments, gas-check pad, wrenches, and screw-drivers [25].

Load!

[32 to 52]

(The gun having been fired.)

251. (1) **Pointer** keeps gun pointed on target.
 (2) **Trainer** keeps gun trained on target and sets training-sight [94].
 (3) **Sight-setter** sets sight [93].
 (4) **Plugman** opens breech and extracts old primer; wipes off breech-plug, screw-box, and gas-check, when necessary [48].
 (5) **Trayman** places loading-tray in screw-box [39].
 (6) **Shellmen** bring shell opposite breech of gun and shove it on loading-tray.
 (7) **Loader**, assisted by trayman, dips combined sponge and rammer in gun-tub; rams shell home with it [33; 47; 51, (4)]; drops rammer; stands by to prime [21, (2); 51, (16)].
 (8) **Powderman** passes powder to trayman, who places it in gun.
 (9) **Trayman** removes loading-tray [39].
 (10) **Plugman** closes plug, keeping contact broken until gun is primed [61]; crosses over to left of breech in so doing, if desirable.
 (11) **Loader** enters primer when plug is nearly closed; closes lock; signals to plugman, who completes contact [105, (3); 51, (16); 61].
 (12) **Plugman** closes plug entirely; signals pointer as soon as gun is ready to fire.

Commence Firing!

[52 to 60]

252. (1) **Pointer** keeps gun pointed on target continuously and fires when ready [38, 57].
 (2) **Trainer** keeps gun trained on target continuously and sets training-sight [38, 57, 94].
 (3) **Sight-setter** sets sights and verifies setting of sight after every shot [93].

Cease Firing!

[60, 61, 62]

253. (1) The service of the gun ceases at this command.
 (2) **Plugman** revolves crank just enough to break firing-circuit [61].
 (3) **Loader** extracts primer [105, 106].

(4) In extracting the primer while firing by percussion, the following method must be observed in all cases, when the lock is cocked:

(5) Grasp the handle of the lock with the right hand and hold back hard; with the left hand grasp the firing-lanyard and release the sear, at the same time lower down the hammer with the right hand, keeping a constant pressure which tends to revolve it to the left. When it is lowered to the proper point the handle will commence to revolve, the wedge will be lowered and the primer extracted.

(6) When using electric firing, proceed as follows: Break the firing-circuit by slightly revolving the plug; grasp the handle of the lock with the right hand, pull it to the rear and at the same time revolve it to the left; at the proper point the handle will commence to revolve, and the wedge be lowered and the primer extracted. Great care must be taken not to pull the handle too far to the rear, for if that is done the lock will be cocked for percussion.

Unload!

[63]

254. (1) **Plugman** opens breech; closes breech after gun is unloaded.

(2) **Trayman** places loading-tray [39]; removes powder and passes it to powderman [63, (2)].

(3) **Loader and trayman** extract shell.

(4) **Shellmen** receive shell.

Secure!

[64]

255. (1) The members of the crew return what they provided and secure what they cast loose.

(2) After actual firing, the members of the crew will assist the gunner's-mate to wash-out, clean, dry, and oil the bore [130].

(3) Gun-captains report to the division-officer when their respective guns are secure.

(4) The members of the crew then form for muster [14, (4); also Plate 3, page 24].

DRILL OF 7-INCH B. L. R.

NOTE.—The drill of the 7-inch B. L. R. has not yet been developed, but it is thought that a modification of the drill for the 6-inch, 50-caliber, B. L. R. will answer for the 7-inch gun.

DRILL OF 5-INCH AND 6-INCH, 50-CALIBER, B. L. R.

NOTE.—Attention is invited to Arts. 2, 3, 4, and 12 to 113.

STATIONS.**256. Gun-crew.**

Title.	Station.
Gun-captain (if extra man).	Where he can best direct the crew.
Plugman.	At operating-lever.
Pointer.	At elevating-wheel.
Trainer.	At training-wheel.
Sight-setter.	At pointing-sight.
Loader.	Left and rear of breech.
1st-Shellman.	Left and rear of breech.
1st-Powderman.	Rear of breech.
2d-Shellman.	Left and rear of breech.
2d-Powderman.	Rear of breech.

Notes.

257. (1) The gun-pointer group will ordinarily consist of three men, the pointer, the trainer, and the sight-setter. The pointer and trainer shall alternately train and point, each one training while the other points and fires. The sight-setter sets the sight of the one who is firing [19, 28, 54, 56, 57, 93, 94, 95].

(2) It will usually be impracticable to assign a separate man as gun-captain. In that event one member of the gun-crew shall be detailed as gun-captain in addition to his other duties. The plugman can usually best perform this duty. Some ships assign one gun-captain to a gun and its opposite; some have one gun-captain for a group of guns. This must necessarily depend on the number of men on board available for the service. As ships will not ordinarily have a spare man for this position, the drill is written as if the plugman acted as captain of the gun-crew. (See Part I, Art. 64.)

(3) The plugman, loader, and shellman should be large, strong, active men. The other members of the gun-crew should be careful, intelligent men, but great strength is not required.

(4) In guns whose ammunition-hoists are considerably removed from their guns an extra shellman or powderman, or both, should be assigned to the crews, in order that they may maintain as rapid a fire as the guns which are more favorably situated [49].

COMMANDS.**[15, 16, 17, 18, 19]**

(To be given by the turret-officer, if necessary.)

258. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and also the setting of the sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

Stations!

(2) At this command, which may be given at any time, the crew go to their stations, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained; the men stand in their tracks and await orders.

Change Stations!

(4) This command should be used occasionally at drill to familiarize the members of the crew with all the duties to be performed at the gun and to show them that every duty requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(5) At this command every man below plugman goes up one station; the plugman becomes 2d-powderman. The gun-pointer group at this command to be kept intact, except that the pointer and trainer change places.

Cast Loose and Provide!**[20 to 32]**

(Secured for sea.)

259. (1) The whole crew clear away gun-lashings and clear away port-shutters.

(2) **Gun-captain** commands; sees gun and mount in working order [29]; supervises all tests; sees accessories and spare parts at hand [109]; reports to officer of division when all is ready.

(3) **Plugman** ships lock; connects firing-attachment at lock;

examines breech-mechanism [27; 29; 51, (9)]; provides and puts on belt with primers [21, (2)]; provides lanyard for percussion-firing [26]; provides priming-wire [26; 51, (19)] and hand primer-extractor; assists 2d-shellman to remove tompion [22]; examines bore and reports "Bore clear" [32].

NOTE.—(a) Care must be taken in shipping the lock to see that the wedge-rack is properly engaged with its pinion, otherwise the operating-lever will not lock when the breech is closed, or the contact-piece of the hammer will not make contact with the firing-pin. The primer-seat should be wiped out to keep it clean and free from oil.

(b) The nuts securing the firing-wire to the contact-piece must be set up tight enough to insure good contact, but not so hard as to prevent the wire from turning freely on the contact-piece. The gas-check seat must be carefully examined for burrs, and if any are found they must be removed with a half-round file.

(4) **1st-pointer** provides and connects electric firing-attachment at pistol-grip and battery-box; tests elevating-gear; tests firing-circuit [21]; at night provides and connects battle-lantern.

NOTE.—Test the circuit by firing a primer [96, (2)].

Care must be taken to see that all contacts are bright, all plugs pushed home securely, and all binding-posts set up hard.

(5) **Trainer** places training-sight; tests training-gear [29, (2)].

NOTE.—The training-shaft should be thoroughly examined to see that all the pins etc., are in place. Special care must be taken to see that taper-pins are in tight. Any lost motion in the training-gear will be increased by the constant cleaning of the gear-wheels, therefore it is preferable to cover them with heavy oil or grease rather than to keep them bright.

(6) **Sight-setter** provides all sights; places pointing-sights; at night sees electric connections for night-sights made [95]; provides material for cleaning lenses [28].

(7) **Loader** provides combination sponge and rammer [47], and bore-sponge, and wets them [26].

(8) **1st-shellman** provides waste and vaseline [33]; provides two right-handed shellman's gloves; provides shell ready for loading [24].

(9) **2d-shellman** removes tompion; provides shell ready for loading [24].

(10) **1st-powderman** takes off muzzle-bag; provides powder-tray (if used) and one charge of powder [24, 41].

(11) **2d-powderman** provides bucket filled with water and marine-sponge; provides powder-charge [24, 41].

(12) **Gunner's-mate** provides tourniquets, fine half-round files, spare parts, shell-extractor, waste, vaseline, bag of sand, copper or brass drifts, maul, fuse-cutter, if required [109].

NOTE.—The spare parts, which should be provided for target-practice or in action, should consist of the following: Lock, firing-attachments, gas-check pad, wrenches and screw-driver.

Load!

[32 to 52]

(The gun having been fired.)

260. (1) **Pointer** keeps gun pointed on target.
- (2) **Trainer** keeps gun trained on target; sets training-sights [94].
- (3) **Sight-setter** sets sight [93].
- (4) **Plugman** opens breech, extracts old primer and puts in a new one [21, (2); 51, (16)]; wipes off breech-plug, screw-box, and gas-check, when necessary [48].

NOTE.—(a) The old primer usually extracts automatically, but a hand primer-extractor should be at hand, in case the primer sticks.

(b) It will seldom be necessary to wipe off the breech-plug, screw-box or gas-check, unless dirt or powder gets into the screw-box.

(c) After repeated firing, the expansion of the gas-check pad makes the operation of closing the breech more difficult, a little tallow applied to the rim of the pad has been found useful.

(d) The operating-lever must be kept pressed back during the loading in order to keep the loading-tray in exact position for loading.

(e) It is thought that the best plan is to open and close the breech with the left hand and to enter the primer with the right hand, the plugman standing just to the right and rear of the breech.

- (5) **Shellman** places shell on loading-tray [39]; goes for another shell; when using shrapnel, sets fuse.

NOTE.—The shellman should take his position just to the left of the gun and a little to the rear, so that when the gun is out to battery he is to the rear and left of the breech. Instruct the shellman to grasp the shell under the base with the right hand, rest it in the hollow of the left arm so that it is nearly balanced, and place it on the loading-tray. The shell should be supported entirely by the left arm. The shellmen alternate in loading.

- (6) **Loader** seats shell, using combination sponge and rammer [33; 47; 51, (4)].

(7) **1st-powderman** holds powder-tray, containing charge, in both hands, and, as soon as shellman steps clear of the breech, enters powder in screw-box.

(8) **2d-powderman** places charge on powder-tray and steps up to breech with 1st-powderman, and with left hand pushes the charge into the chamber just clear of the screw-box; picks up another charge.

(9) **Plugman** closes breech.

NOTE.—The plugman must see that the primer is fully home before attempting to close the breech, otherwise the primer is sure to be jammed in closing.

Commence Firing!**[52 to 60]**

261. (1) **Pointer** keeps gun pointed on target continuously, and fires when ready [38, 57].

(2) **Trainer** keeps gun trained on target continuously; sets training-sight [38, 57, 94].

(3) **Sight-setter** sets sights and verifies setting of sight after each fire [93].

Cease Firing!**[60, 61, 62].**

262. (1) The service of the gun ceases at this command.

(2) **Plugman** pulls back operating-lever just enough to break firing-circuit [61]; then extracts primer by lowering wedge [105, 106].

Unload!**[63]**

263. (1) **Plugman** opens breech.

(2) **2d-powderman** withdraws charge and returns it to powder-tank [63, (2)].

(3) **Shellmen** extract shell.

(4) **Plugman** closes breech.

Secure!**[64]**

264. (1) The members of the crew return what they provided and secure what they cast loose.

(2) After actual firing, the members of the crew will assist the gunner's-mate to wash out, clean, dry, and oil the bore [130].

(3) Gun-captains report to the division-officer when their respective guns are secure.

(4) The members of the crew then form for muster [14, (4); also Plate 3, page 24].

DRILL FOR 6-INCH, 40-CALIBER, R. F. GUN. MARK IV.

(Mark IV gun, fitted with Fletcher Breech-Mechanism; training-gear on right of gun.)

NOTE.—Attention is invited to Arts. 5 and 12 to 113. Particular attention is invited to Arts. 5 and 50.

STATIONS.

265.

Gun-crew.

Title.	Station.
Gun-captain (if extra man).	Where he can best direct the crew.
Plugman.	At operating-lever.
Pointer.	At elevating-wheel.
Trainer.	At training-wheel.
Sight-setter.	At pointing-sight.
1st-Shellman.	To left and rear of breech.
2d-Shellman.	To left and rear of breech.
1st-Powderman.	In rear of breech.
2d-Powderman.	In rear of breech.

Notes.

266. (1) The gun-pointer group will ordinarily consist of three men, the pointer, the trainer, and the sight-setter. The pointer and trainer shall alternately train and point, each one training while the other points and fires. The sight-setter sets the sight of the one who is firing [19, 28, 54, 56, 57, 93, 94, 95].

(2) It will usually be impracticable to assign a separate man as gun-captain. In that event one member of the gun-crew shall be detailed as gun-captain in addition to his other duties. The plugman can usually best perform this duty. Some ships assign one gun-captain to a gun and its opposite; some have one gun-captain for a group of guns. This must necessarily depend on the number of men on board available for the service. As ships will not ordinarily have a spare man for this position, the drill is written as if the plugman acted as captain of the gun-crew. (Part I, Art. 64.)

(3) The plugman, loader, and shellman should be large, strong, active men. The other members of the gun-crew should be careful, intelligent men, but great strength is not required.

(4) In guns whose ammunition-hoists are considerably removed from their guns, an extra shellman or powderman, or

both, should be assigned to the crews, in order that they may maintain as rapid a fire as the guns which are more favorably situated [49].

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the division-officer, if necessary.)

267. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and also the setting of the sight for lateral compensation); **COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

Stations!

(2) At this command, which may be given at any time, the crew go to their stations, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained; the men stand in their tracks and await orders.

Change Stations!

(4) This command should be used occasionally at drill to familiarize the members of the crew with all the duties to be performed at the gun and to show them that every duty requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(5) At this command, every man below plugman goes up one station; the plugman becomes 2d-powderman. The gun-pointer group is at this command to be kept intact, except that the pointer and trainer change places.

Cast Loose and Provide!

[20 to 32]

268. (1) Gun-captain commands; sees gun and mount in working order [29]; supervises all tests; sees accessories and spare parts at hand [109]; reports to division-officer when all is ready; if separate man, supervises setting of fuse when using shrapnel.

(2) **Plugman** examines breech-mechanism [27; 29; 51, (9)] and bore of the gun; reports "Bore clear" [32]; assists 2d-shellman to remove tompion; provides loading-tray [39].

NOTE.—In the examination of the breech-mechanism, the firing-case should be removed to see that the joint is tight. After the firing-case is put back, the firing-point should be carefully examined to see that it is not broken or bent and that it is properly centered. This last point is very important, for if it touches the breech at all, a short circuit will result. The point of a *bent* firing-pin may touch the plug when the gun is loaded and when the pin is consequently pressed back by the primer, and still not touch it when the plug is open, because in the latter case the pin is in its forward position, with its bent point clear of the plug.

The extractor should be examined, as a case has been known where the extractor was burred in putting the shell home. The chamber should be carefully examined for burrs; and, if any are found, they should be removed with a smooth half-round file. In examining the bore, care must be taken to see that it is perfectly clear. This also gives a check on the removal of the tompion.

(3) **Pointer** provides and connects firing-attachments; tests firing-circuit [21; 96, (2)]; tests elevating-gear [29, (2)]; at night provides and connects battle-lantern.

NOTE.—(a) Care must be taken to see that all contacts are bright, that all plugs are pushed home securely, and that all binding-posts are set up hard.

(b) A quick and ready means of testing the firing-circuit is to close the firing-key and then close the breech. At the same time watch the contact between the attachment-lug and the firing-case. If there is sufficient current, a spark will be seen when the circuit is made and broken.

(4) **Trainer** tests training-gear [29, (2)]; places training-sight.

NOTE.—The training-shafts should be thoroughly examined to see that all the pins, etc., are in place. The friction-gear on the right side of the gun should be set up, and that on the left side slackened off so that the gun can be trained from the right side. Special care must be taken to see that all the taper-pins are tight.

Any lost motion in the training-gear will be increased by the constant cleaning of the gear-wheels, therefore covering them with a heavy oil or grease is preferable to keeping them bright.

(5) **Sight-setter** provides all sights and places pointing-sight; at night sees electric connections for night-sights made [95]; provides material for cleaning lenses [28, 84].

(6) **1st-shellman** provides two right-handed shellman's-gloves and gives one to 2d-shellman; provides shell ready for loading [24].

(7) **2d-shellman** removes tompion; then provides shell ready for loading [24].

(8) **1st-powderman** provides two pairs of loaders'-gloves; puts on one pair and gives other pair to 2d-powderman; provides cartridge-case, wipes clean [44], ready for loading [24, 41, 42].

(9) **2d-powderman** removes muzzle-bag; then provides cartridge-case and prepares it for loading [24, 41, 42, 44].

(10) **Gunner's-mate** provides tourniquets, fine half-round files, bore- and chamber-sponges [48, (3)], fuse-cutter, if required, spare parts, copper or brass drifts, maul, extension for operating-lever, hand case-extractor, shell-extractor, waste, bag of sand [109].

NOTE.—The spare parts, which would be provided only at target-practice or in action, should consist of the following: Firing-case, extractor, firing-attachment, wrenches, and screw-drivers.

Load!

[32 to 52]

(The gun having been fired.)

269. (1) **Pointer** keeps gun pointed on target continuously.

(2) **Trainer** keeps gun trained on target [38]; sets training-sight [94].

(3) **Sight-setter** sets sight [93].

(4) **Plugman** opens breech with the right hand.

NOTE.—Care must be taken to keep breech fully open. If this is not done there is danger of case hitting and bending the firing-point, unless pin houses automatically when breech is opened.

(5) **1st-powderman** removes empty case and either throws it overboard or lays it to one side [41, 55]; provides another charge and prepares for loading [49].

(6) **Plugman** places loading-tray in the screw-box with left hand. The loading-tray should be put in by reaching up with the left hand under the breech.

(7) **Shellman** places shell on loading-tray and shoves it home with right hand [33; 51, (4)]; goes for another shell [49]; in shrapnel-fire he sets fuse in accordance with directions of division-officer, or gun-captain, or sight-setter. The shellmen alternate in loading.

NOTE.—(a) There is no difficulty in shoving the shell home by hand if it is properly centered and shoved home straight.

(b) The shellman should take his position just to the left of the gun and a little in rear, so that when the gun is out to battery he is to the rear and left of the breech. In order not to burr the chamber, it is best not to attempt to *throw* the shell home. The object is to get the shell home in the shortest possible time with the least effort. Instruct the shellman to grasp the shell under the base with the right hand and rest it in the hollow of the left arm so that it is nearly balanced. Place it on the loading-tray and, at the same time, give it a shove with the right hand, fist closed. With a little practice, the motion of putting the shell on the tray and shoving it home can be made continuous. The shell should be supported entirely by the left arm, the right hand being used only to guide it.

(8) **Plugman** removes loading-tray as soon as shell is clear [39].

(9) **2d-powderman** places cartridge in the gun, steps back clear of the recoil, and stands by to take out the empty case after the gun has been fired.

NOTE.—The cartridge should be carried by grasping the base with the right hand and resting it in the hollow of the left arm. In putting it in, care must be taken to center it properly and shove it entirely home, that is, until it takes against the extractor. In actual firing, when smoke is pouring out of the powder-chamber inserting the cartridge-case, especially when its end is not rounded off, is a very different matter from inserting it in the empty chamber at drill, and considerable delay is frequently caused. This can be avoided by depressing the rear end of the case until the forward end is started into the chamber, then raising the rear end and shoving it in.

(10) **Plugman** closes breech.

NOTE.—If there is no catch on the operating-lever, the hand must follow the lever until it brings up against the rear face of the gun. If the lever is released before that time, it will rebound and the electric contact may be broken. For the same reasons, care must be taken not to pull the lever back when the hand is removed. The lever should not be grasped during the latter part of the motion of closing, but the hand should be flat against it. Many officers prefer to have plugman cross over in closing and opening breech, and this method may be used if desired.

Commence Firing!

[52 to 60]

270. (1) **Pointer** keeps gun pointed on target continuously and fires when ready [38, 57].

(2) **Trainer** keeps gun trained on target continuously and sets training-sight [38, 57, 94].

(3) **Sight-setter** sets pointing-sight and verifies setting of sight after each fire [93].

Cease Firing!

[60, 61, 62]

271. (1) The service of the gun ceases at this command.

(2) **Plugman** opens breech; closes it after cartridge is removed.

(3) **Powderman** takes out cartridge and puts it with the unused ammunition which may have been provided; if gun has just fired, removes empty case and puts it with the other empty cases [41].

Unload!

[63]

272. (1) **Plugman** puts in loading-tray [39].

(2) **Shellmen** extract shell.

(3) **Plugman** removes loading-tray; closes breech.

Secure!

[64]

273. (1) The members of the crew return what they provided and secure what they cast loose.

(2) After actual firing, the members of the crew will assist the gunner's-mate to wash out, clean, dry, and oil the bore [130].

(3) Gun-captains report to the division-officer when their respective guns are secure.

(4) The members of the crew then form for muster [14, (4); also Plate 3, page 24].

DRILL FOR A 5-INCH, 40-CALIBER, RAPID-FIRE GUN. (Also for a 4-inch R. F. Gun with Training-Gear on Right.)

NOTE.—Attention is invited to Arts. 5 and 12 to 113. Particular attention is invited to Arts. 5 and 50.

STATIONS.

274.

Gun-crew.

Title.

Station.

Gun-captain (if extra man).	Where he can best direct the crew.
Plugman.	On left of breech at operating-lever.
Pointer.	At elevating-wheel.
Trainer.	At training-wheel.
Sight-setter.	At pointing-sight.
1st-Shellman.	To left and rear of breech.
2d-Shellman.	In rear of 1st-shellman.
3d-Shellman.	In rear of 2d-shellman.

Notes.

275. (1) **The gun-pointer group** will ordinarily consist of three men, the pointer, the trainer, and the sight-setter. The pointer and trainer shall alternately train and point, each one training while the other points and fires. The sight-setter sets the sight of the one who is firing [19, 28, 54, 56, 57, 93, 94, 95].

(2) It will usually be impracticable to assign a separate man as gun-captain. In that event one member of the gun-crew shall be detailed as gun-captain, in addition to his other duties. The plugman can usually best perform this duty. Some ships assign one gun-captain to a gun and its opposite; some have one gun-captain for a group of guns. This must necessarily depend on the number of men on board available for the service. As ships will not ordinarily have a spare man for this position, the drill is written as if the plugman acted as captain of the gun-crew. (Part I, Art. 64.)

(3) The members of the gun-crew should be careful, intelligent men, but owing to the weight of the cartridge, great strength is not required.

(4) In guns whose ammunition-hoists are considerably removed from their guns, an extra shellman or powderman, or both, should be assigned to the crews, in order that they may maintain as rapid a fire as the guns which are more favorably situated [49].

COMMANDS.**[15, 16, 17, 18, 19]**

(To be given by the officer of the division, if necessary.)

276. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, sight-bar range, and the setting of the sight for lateral compensation); **COMMENCE FIRING!** **CEASE FIRING!** **UNLOAD!** **SECURE!**

NOTE.—In actual firing, very few commands are necessary. The firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence and, as much as possible, without commands.

Stations!

(2) At this command, which may be given at any time, the crew take their stations at the gun, stand and maintain silence.

Silence!

(3) At this command, given at any time, all operations cease instantly; every man stands in his tracks and awaits orders.

Change Stations!

(4) This command should be used occasionally at drill to familiarize the members of the crew with all the duties to be performed at the gun and to show them that every duty requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(5) At this command, every man below plugman goes up one station; the plugman becomes 3d-shellman. The gun-pointer group is at this command to be kept intact, except that the pointer and trainer change places.

Cast Loose and Provide!**[20 to 32]**

(Guns secured for sea.)

277. (1) The whole crew cast off gun-lashings, and clear away port-shutters.

(2) The gun-captain (whether a separate number or one of the regular crew) commands; exercises general supervision, but gives specific instructions as the case may require; sees gun and mount in working order [29]; sees that all required articles, including accessories and spare parts, are provided by

the crew, and that they are properly placed [109]; reports to the division-officer when all is ready.

(3) **Plugman** examines breech-mechanism [27; 29; 51, (9)] and bore of the gun; assists 2d-shellman to remove tompion; reports "Bore clear" [32].

NOTE.—(a) Some officers equip plugman with a pair of loader's-gloves.
 (b) The examination of the breech should consist of the following: Take out the firing-case and see that the joint is tight. Examine the extractor and chamber for burrs; if any are found remove them with a smooth, half-round file. This is necessary to prevent the cartridge-case from jamming. After putting back the firing-case, examine firing-point carefully, to see that it is not broken or bent, and that it is properly centered; this is very important, for, if the firing-point is not properly centered, a short circuit will result when the plug is closed and the firing-pin is forced back into the breech-plug. Look through the bore to see that it is clear. This also gives a check on the removal of the tompion.

(4) **Pointer** provides and connects the firing-attachments; tests firing-circuits [21; 96, (2)]; tests elevating-gear [29, (2)]; at night provides and connects battle-lantern.

NOTE.—(a) Care must be taken to see that the contacts are bright, all plugs pushed home securely, and that all binding-posts are set up hard.

(b) A quick and ready means of testing the firing-circuit is to close the firing-key and then close the breech of the gun; at the same time, watch the contact between the attachment-lug and firing-case for a spark. If there is sufficient current, a spark will be seen when the circuit is made and broken. In some guns, it may be necessary to short-circuit the firing-point. This can be done by placing a pin between the firing-point and hole in the face of the plug.

(5) **Trainer** places training-sight; tests training-gear [29, (2)].

NOTE.—The training-shafts should be thoroughly examined to see that all the pins, etc., are in place. The friction-gear on the right side of the gun should be set up hard and that on the left be slackened off so that the gun can be trained only from the right side. Special care must be taken to see that all the taper-pins are tight.

Any lost motion in the training-gear will be increased by the constant cleaning of the gear-wheels, therefore thoroughly covering them with heavy oil or grease is preferable to keeping them bright.

(6) **Sight-setter** provides all sights and places pointing-sight; at night sees electric connections for night-sights made [95]; provides material for cleaning lenses [28, 84].

(7) **1st-shellman** provides three pairs of loader's-gloves; puts on one pair and gives the others to the other shellmen; when using shrapnel, sets fuse as directed by division-officer or gun-captain, sight-setter giving time, when required; takes a piece of waste; provides cartridge; wipes it clean [43], ready for loading [24, 42].

NOTE.—If shrapnel are being used against torpedo-attack, the fuses would probably be set previous to the attack and the shell laid out in rows, say $\frac{1}{2}$, 1, $1\frac{1}{2}$, and 2 seconds, and marked to indicate their fuse setting. The shellman would then use shells from the row designated. Rapidity of fire could never be attained by other methods.

(8) **2d-shellman** removes tompion [22]. Then same duties as 1st-shellman [24, 42, 43].

(9) **3d-shellman** takes off muzzle-bag. Then same duties as 1st-shellman [24, 42, 43].

(10) **Gunner's-mate** provides or sees at hand tourniquets, fine half-round files, bore and chamber bristle-sponges, fuse-cutter, if required, spare parts, copper or brass drift, extension for operating-lever, case-extractor, shell-extractor, waste, bag of sand; issues sights and their attachments, firing-attachments [109].

NOTE.—The spare parts, which would be provided only at target-practice, general quarters, or in action, should consist of the following: firing-case, extractor, firing-attachments, wrenches, and screw-drivers.

Load!

[32 to 52]

(The gun having been fired.)

278. (1) **Pointer** keeps gun pointed on target.

(2) **Trainer** keeps gun trained on target [38]; sets training-sight [94].

(3) **Sight-setter** sets sight [93].

(4) **Plugman** opens breech.

NOTE.—(a) This is done with the left hand on the operating-lever and with full-arm swing, at the same time crossing from the left to the right side of gun. Care must be taken to keep the breech-plug fully open, i. e., the operating-lever hard against the extractor at full throw. If this precaution is not taken there is danger of bending the firing-point (where exposed) in removing the cartridge-case.

(b) Sometimes the throw of the extractor is not great enough to loosen the cartridge-case sufficiently to permit its being handled. In this case, the breech should be closed far enough to push the case nearly home and then opened *smartly*.

(c) If the cartridge-case jams, so that the extractor cannot be started, a lever placed on the handle of the operating-lever will give additional leverage. If necessary the shellman waiting for the empty case will assist.

(5) **1st-shellman** removes empty case and either throws it overboard or takes it to one side [41 to 47]; goes for another cartridge.

NOTE.—The shellmen alternate in this duty, i. e., the shellman that places the cartridge in the gun removes the empty case; the shellman should move directly to the rear until clear of the gun, and then off to the right so as to be clear of the shellman who comes next in the operation of loading.

(6) **2d-shellman** places cartridge in gun [41, 45, 46, 49]; stands by to receive empty case.

NOTE.—The shellman places himself in rear of the gun so that the cartridge is directly in rear and in line with the bore; enters the shell fair

in the powder-chamber and shoves the case home so that it takes up against the extractor; then steps to the rear, clear of the recoil, and stands by to take out the empty case after the gun has been fired.

(7) **Plugman** closes breech with right hand with full-arm swing, crossing to the left side of the gun as quickly as possible, and as soon as the breech is closed, touches the pointer with the left hand as a signal that the gun is ready to fire, remaining to the left of the breech.

NOTE.—If there is no catch on the operating-lever, the hand must follow the lever until it brings up against the rear face of the gun. If the lever is released before that time, it will rebound and the electric contact will be broken. For the same reason, care must be taken not to pull the lever back when hand is removed.

The lever should not be grasped during the latter part of the motion of closing, but the hand should be flat against it.

Commence Firing!

[52 to 60]

279. (1) **Pointer** keeps gun pointed on target continuously and fires when ready [38, 57].

(2) **Trainer** keeps gun trained on target continuously; sets training-sight [94].

(3) **Sight-setter** sets sight; verifies setting of sight after each fire [93].

(4) **Gun-captain** superintends the working of the crew as a team.

Cease Firing!

[60, 61, 62]

280. (1) Service of gun ceases at this command.

(2) **Plugman** opens breech.

(3) **Shellman** withdraws cartridge and places it with the unused ammunition which may have been provided; if the gun has just fired, removes empty case and places it with other empty cases [41].

(4) **Plugman** closes breech.

Unload!

[63]

281. This command is given with R. F. guns using fixed ammunition when the gun is loaded but before COMMENCE FIRING! is given. Gun is then unloaded as in CEASE FIRING!

Secure!**[64]**

282. (1) The members of the crew return what they provided and secure what they cast loose.

(2) After actual firing, the members of the crew will assist the gunner's-mate to wash out, clean, dry, and oil the bore [130].

(3) Gun-captains report to the division-officer when their respective guns are secure.

(4) The members of the crew then form for muster [14, (4); also Plate 3, page 24].

DRILL FOR 5-INCH R. F. GUN. MARK II.

On a directing-bar mount.

Also for a 4-inch R. F. Gun, Mark V.

On a Mark IV mount converted to Mark VII.

NOTE.—The term “directing-bar mount” is used herein to refer to the Mark I type of 4-inch and 5-inch mounts. This mount must not be confused with the old Parrott directing-bar mount which is now obsolete.

NOTE.—Attention is invited to Articles 5 and 12 to 113. Particular attention is invited to Arts. 5 and 50.

STATIONS.

283.

Gun-crew.

Title.	Station.
Gun-captain (if extra man).	Where he can best direct the crew.
Plugman.	At operating-lever.
Pointer.	At elevating-wheel.
Trainer.	At training-wheel.
Sight-setter.	At pointing-sight.
1st-shellman.	Left and rear of breech.
2d-shellman.	Left and rear of breech.
3d-shellman.	Left and rear of breech.

Notes.

284. (1) The gun-pointer group will ordinarily consist of three men, the pointer, the trainer and the sight-setter. The pointer and trainer shall alternately train and point, each one training while the other points and fires. The sight-setter sets the sight of the one who is firing [19, 28, 54, 56, 57, 93, 94, 95].

(2) It will usually be impracticable to assign a separate man as gun-captain. In that event one member of the gun-crew shall be detailed as gun-captain in addition to his other duties. The plug-man can usually best perform this duty. Some ships assign one gun-captain to a gun and its opposite, some have one gun-captain for a group of guns. This must necessarily depend on the number of men on board available for the service. As ships will not ordinarily have a spare man for this position, the drill is written as if the plugman acted as captain of the gun-crew. (Part I, Art. 64.)

(3) The members of the gun-crew should be careful, intelligent

men, but owing to the weight of the cartridge, great strength is not required.

(4) In guns whose ammunition-hoists are considerably removed from their guns, an extra shellman or powderman, or both, should be assigned to the crews, in order that they may maintain as rapid a fire as the guns which are more favorably situated [49].

COMMANDS.

[15, 16, 17, 18, 19]

(To be given by the division-officer, if necessary.)

285. (1) CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and also the setting of the sight for lateral compensation); **COMMENCE FIRING!** **CEASE FIRING!** **UNLOAD!** **SECURE!**

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

Stations!

(2) At this command, which may be given at any time, the crew go to their stations, stand and maintain silence.

Silence!

(3) At this command, which may be given at any time, perfect silence is maintained; the men stand in their tracks and await orders.

Change Stations!

(4) This command should be used occasionally at drill to familiarize the members of the crew with all the duties to be performed at the gun and to show them that every duty requires skill and care properly to perform it. It tends to make the crew more helpful to one another in the performance of their duties.

(5) At this command, every man below plugman goes up one station; the plugman becomes 3d-shellman. The gun-pointer group is at this command to be kept intact, except that the pointer and trainer change places.

Cast Loose and Provide!

[20 to 32]

(Gun secured for sea.)

286. (1) The whole crew cast off gun-lashings and clear away port-shutters.

(2) **Gun-captain** commands; sees gun and mount in working order [29]; supervises all tests; sees accessories and spare parts at hand [109]; reports to officer of division when all is ready; if extra man, when using shrapnel, supervises setting of fuse.

(3) **Plugman** examines breech-mechanism [27; 29; 51, (9)] and bore of gun; assists second shellman to remove tompion; reports "Bore clear" [32].

NOTE.—In this examination the firing-point should be examined to see that it is not bent or broken and that it is properly centered. This is very important, for a bent firing-pin which does not touch the plug when open, will frequently do so when the gun is loaded and the firing-pin forced back. The chamber and bore should be searched for burrs, the extractor examined to see that it is intact and is not burred. See that the bore is clear, and that the tompion is removed.

(4) **Pointer** provides and connects firing-attachments; tests firing-circuit [21; 96, (2)]; tests elevating-gear [29, (2)]; at night provides and connects battle-lantern.

NOTE.—(a) Care must be taken to see that all contacts are bright, plugs all pushed in securely, and binding posts set up hard.

(b) A quick and ready means of making this test is to close the firing-key and then close the breech of the gun, at the same time watch the contact between the attachment-lug and the firing-case for a spark. If there is sufficient current, a spark will be seen when the circuit is made and broken. In some guns it may be necessary to short-circuit the firing-point. This may be done by placing a pin between the firing-point and the hole in the face of the plug.

(5) **Trainer** places training-sight; tests training-gear [29, (2)].

NOTE.—In this test the training-shafts should be thoroughly examined to see that all pins, etc., are in place. The friction-gear should be set up tight. Special care must be taken to see that all taper-pins are in tight.

(6) **Sight-setter** provides all sights; places pointing-sight; provides material for wiping off lenses [28, 84]; at night sees electric connections for night-sights made [95].

(7) **1st-shellman** provides three pair of loader's-gloves, one pair each for 2d- and 3d-shellman; when using shrapnel, sets fuse as directed by division-officer or gun-captain, sight-setter giving the time when required; takes a piece of waste; provides cartridge; wipes it clean [24, 41, 42, 43].

(8) **2d-shellman** removes tompion [22]. Then same duties as 1st-shellman.

(9) **3d-shellman** takes off muzzle-bag. Then same duties as 1st-shellman.

(10) **Gunner's-mate** provides or sees at hand tourniquets, fine half-round files, bore- and chamber-sponges, fuse-cutter if required, spare parts, copper or brass drift, extension for operating-

lever, case-extractor, shell-extractor, waste, bag of sand; issues sights and their attachments and firing-attachments [109].

NOTE.—The spare parts, which would be provided only at general quarters, target-practice, or in action, should consist of the following: Firing-case, extractors, firing-attachments, wrenches, and screw-drivers.

Load!

[32 to 52]

(The gun having been fired.)

287. (1) **Pointer** keeps gun pointed on target; at guns without training-sights, directs training.

(2) **Trainer** keeps gun trained on target [38]; sets training-sights [94].

NOTE.—At guns without training-sights, the trainer keeps gun trained as directed by pointer.

(3) **Sight-setter** sets sight [93].

(4) **Plugman** opens breech.

(5) **1st-shellman** removes empty case and throws it overboard or lays it to one side and picks up another cartridge [41, 45, 46, 49].

(6) **2d-shellman** places cartridge in gun and stands by to take out empty case after the gun has been fired [41, 45, 46, 49].

NOTE.—In loading, the cartridge should rest in the hollow of the left arm with the right fist against the base. Quickly but carefully place the nose of the shell in the chamber and push it smartly home with the right fist, care being taken to keep the fist firmly against the cartridge until it takes up against the rear face of the chamber. If this precaution is not taken the cartridge may rebound or the shell jam before it is home, which may cause the firing-pin to be bent in closing the breech. Great care must be taken not to bend the firing-pins in guns of this class, where the firing-pins are not housed automatically, when the breech is opened. The pin sticks out about one-eighth of an inch, and if bent it will touch the breech-plug and cause a short circuit, thus ensuring a miss-fire. The loaders must have this in mind in loading and in withdrawing empty cases. Never swing the cartridge up to the bore but place it carefully in the chamber and then shove it home smartly. If the shell is *thrown* into the gun with any force the nose is very apt to raise a burr on the soft metal of the gun-tube, which will cause the cessation of fire until it can be removed. This is particularly true of the blunt-nose shell furnished for target-practice.

(7) **Plugman** closes breech, signals pointer when gun is ready.

Commence Firing!

[52 to 60]

288. (1) **Pointer** keeps gun pointed on target continuously, and fires when ready.

(2) **Trainer** keeps gun trained on target continuously; sets training-sights [54, 94].

(3) **Sight-setter** sets sight and verifies setting of sight after each fire [93].

Cease Firing!

[60, 61, 62]

289. (1) The service of the gun ceases at this command.

(2) **Plugman** opens breech.

(3) **Shellman** withdraws cartridge and places it with the unused ammunition.

(4) **Plugman** closes breech.

Unload!

[63]

290. This command is given with R. F. guns using fixed ammunition, when the gun is loaded, but before COMMENCE FIRING! is given. The gun is then unloaded as in CEASE FIRING!

NOTE.—For the 4-inch, 50-caliber, gun the drill is the same as the above. In case of a miss-fire with one form of firing, the gun is immediately to be fired by the other [102].

Secure!

[64]

291. (1) The members of the crew return what they provided and secure what they cast loose.

(2) After actual firing, the members of the crew will assist the gunner's-mate to wash out, clean, dry, and oil the bore [130].

(3) Gun-captains report to the division-officer when their respective guns are secure.

(4) The members of the crew then form for muster [14, (2); also Plate 3, page 24].

NOTES ON DRILLS FOR SECONDARY- AND MACHINE-GUNS.

NOTE.—The following are special notes, applicable to guns of the secondary-battery only. Many of the notes on drills of R. F. guns of the main-battery apply also to guns of the secondary-battery, and the attention of officers commanding the latter is invited to all notes on main-battery guns which are applicable to them.

292. The secondary-battery is composed of all guns of 3-inch caliber or less, which are mounted on board ship.

293. Gun-pointer group.—With the exception of the 3-inch R. F. G. (the gun-pointer group of which consists of three men, as in 4-, 5-, and 6-inch broadside guns), the gun-pointer group for secondary-guns consists of two men, the 1st- and 2d-pointer, who relieve each other at pointing; and who act as sight-setters for each other.

294. The commands in the drills of secondary-guns are in all respects the same as for guns of the main-battery, and the stations are as similar as the difference of the respective classes of guns permit. In secondary-guns, as in main-battery guns, one member of the crew will act as captain of the gun-crew. The plugman is usually assigned this duty on account of his advantageous position for supervising the movements of the gun-crew. This duty should never be assigned to one of the pointers, except in the case of machine-guns. Men assigned the duty of captain of secondary-guns do not draw extra pay by virtue of such assignment.

295. Some ships assign one petty-officer to command a group of these guns, thus relieving a division-officer in cases where the guns of a division are widely separated, as is frequently the case with guns of the secondary-battery.

296. The members of secondary gun-crews should be careful, intelligent men, but great strength is not required.

297. In the case of guns whose hoists are at a considerable distance, it may become necessary to assign additional shellmen in order that rapidity of fire may not suffer from lack of ammunition. In such instances these additional men may, if desirable, be actually assigned to the crew, or they may simply be detailed as a squad, to bring ammunition from the hoist to the neighborhood of the remote group of guns.

298. (1) Commands.—CAST LOOSE AND PROVIDE! LOAD! (designating object, direction, range, and lateral compensation); COMMENCE FIRING! CEASE FIRING! UNLOAD! SECURE!

NOTE.—Very few commands should be necessary; the firing of the gun is the signal to prepare the gun for another discharge. The crew should be trained to work in silence, and, as far as possible, without commands.

(2) **Stations!**—At this command, which may be given at any time, the crew take stations at the gun, stand and maintain silence.

(3) **Silence!**—At this command, which may be given at any time, perfect silence is maintained, the men stand in their tracks and await orders.

(4) **Change stations!**—This command should be used occasionally at drill to familiarize the members of the crew with all duties to be performed at the gun, and to show them that every duty requires skill and care properly to perform it.

(5) At the command *Change stations*, the 1st- and 2d-pointers change stations, the regular members of the crew below plugman each go up one station; the plugman becomes shellman.

299. Attention is invited to the detail-notes entered under the drill of 3-pdr. and 6-pdr. R. F. guns, which contain notes more or less applicable to many other secondary-guns.

300. In casting loose secondary-guns, the gun-captain, when in sight of the division-officer, reports his gun by standing with the gun-tompion in his hand, holding it up in sight; the division-officer is then assured that the tompion has been removed from the gun.

301. If a drill-apron is used, the 1st-pointer will adjust it. The drill-apron is used only where the exercise is with drill-cartridges, and even then a gun-swab on deck is preferable.

302. The amount of ammunition to be supplied for every gun as a first supply will be regulated by the commanding officer, and will depend upon the requirements of the situation. In the absence of orders, a full box will be supplied for each gun.

303. With secondary-guns using open-sights, always take a full-sight, that is, the top of the front-sight is brought in line with the top of the rear-sight notch. These open-sights are designed to be used with a full-sight, and if either a fine or a coarse-sight is used the guns will fire short or over, respectively.

304. Miss-fires with R. F. guns are fully treated under the head of miss-fires, Arts. 98-104. It may, however, be added that miss-fires with Hotchkiss guns of the old type are frequently caused by the neglect to remove the drill-hook; and in the case of Driggs-Schroeder guns, by neglect to remove the drill-washers.

305. With either of the above guns, a frequent cause of the failure of the cap to explode is due to the deposit of dirt or

residuum on the front end of the firing-pin, or on rear face of face-plate, which might shorten the throw of the firing-pin and prevent its striking the cap with full force.

306. Broken firing-pin points are also frequent causes of miss-fires. If the primer is not too deeply seated, if the drill-hook or washer has been removed, and if the firing-pin point is intact and face-plate secure, a miss-fire is probably due to a weak main-spring.

307. As is pointed out under notes on miss-fires, the general rule not to try a second time when a cartridge has once failed, is not applicable in guns using percussion-primers only, since the breech-plug *must* be kept closed 20 minutes, hence to try again is the only thing that *can* be done. Such cartridges as fail should be broken down on board ship, the primers removed and sent to the Naval Torpedo Station, and the Bureau of Ordnance informed of the circumstances.

308. The drills herein given are drawn up for the number of men which will produce the maximum efficiency of gun-fire. If the complement is insufficient to allow so large a crew for 1-, 3-, and 6-pdrs., the drill can be carried out readily, but somewhat less efficiently, with a reduced crew.

309. If for any reason a loaded cartridge will not extract, catch the head with the extracting tool and pull it out. If this fails, the cartridge should be fired if possible. If it is impossible to fire the cartridge, it should be forced out (not rammed out), by inserting a spar in the gun and attaching a tackle to it and hauling with a steady pull.

310. (1) In returning ammunition, care must be taken that empty cases are not put in ammunition-boxes containing cartridges.

(2) When firing blank cartridges, empty cases must not be returned to the boxes containing charged cases, for if there is any loose powder in the bottom of the box, it might be ignited with disastrous results. The best method is to place empty cases in buckets containing fresh water, and knock out the caps after firing. This also expels all dangerous gases from the case.

311. The importance of carefully examining all percussion-ammunition before loading it into the gun, to see that the primers are not too deeply set in their seat, cannot be overestimated. This is a frequent cause of miss-fires.

312. (1) Reserve-boxes for the Hotchkiss 6-pdr., 3-pdr. and 1-pdr. guns contain the following accessories and spare parts:

(2) ACCESSORIES.—Sponge-brush, cleaning-brush, oil-can, com-

bination dismounting-tool, dismounting-pin, monkey-wrench, hand-extractor (except for 1-pdr.), drill-hook (except for 1-pdr. and latest types), lanyard-hook.

(3) SPARE PARTS.—Stop-bolt, hammer, firing-pin, main-spring, sear-spring, sear, extractor.

313. (1) **Driggs-Schroeder reserve-boxes** for 6-pdr., 3-pdr., and 1-pdr. guns contain the following accessories and spare parts:

(2) ACCESSORIES.—Babbitt-mallet, sponge-brush, cleaning-brush, oil-can, combination screw-driver, firing-pin wrench, block-support, hand-extractor, face-plate, drift, drill-washers.

(3) SPARE PARTS.—Firing-spring, firing-pin, right and left extractors, sear, sear-spring, set of gun-screws.

314. (1) **Maxim-automatic 1-pdr. reserve-boxes** contain:

(2)

ACCESSORIES.

5 Ammunition-boxes.	1 Pliers.
10 Ammunition-belts, 25 cartridges each.	1 Extractor for broken shell.
1 Hammer, bronze.	4 Punches (special).
1 Hammer, lead, 5 lbs.	1 Clearing-rod, No. 1.
4 Combination spanners.	2 Screw-drivers (1 large, 1 small).
1 Barrel butt-spanner.	1 Copper punch, $\frac{3}{4}$ -inch diam.
1 Cleaning brush.	1 Copper punch, 1-inch diam.
1 Oil-can.	

(3)

SPARE PARTS.

1 Safety-sear spring.	2 Firing-pin points.
1 Safety-sear-spring pin.	2 Split-pins for taper-pins.
1 Bottom-pawl spring.	2 Split-pins for safety-indicator.
1 Top-pawl spring.	2 Split-pins for cover-hinge-pin.
1 Lock-mainspring.	1 Split-pin for roller-nut.
1 Trigger-spring.	1 Barrel-spring packing-ring.
1 Trigger-bar spring.	2 Buffer packing-rings.
1 Carrier-holding-up spring.	1 Tumbler-spring pin.
1 Ejection-tube spring.	2 Asbestos packing.
2 Cam-pawl spring.	1 Side-box spring.
1 Gib-spring.	1 Spare mechanism, lock.
1 Tail-spring.	
6 Tail-spring rivets.	
1 Side-lever-spring pin.	

(4) Each vessel carrying one or more of these guns is supplied with:

- Cam-handle withdrawing-tool.
- Side-box spring winding device.
- Funnel for filling water-jacket.
- Funnel for filling buffer-cylinders.

315. **Lard oil** should not be used on any part of the mechanism, as it hardens in cold weather. Mineral or fish oil is better, but vaseline is best.

316. **With the recoil mount**, a trigger-lanyard should be provided, as the pistol-grip cannot be held without danger of dislocating the pointer's wrist. This applies of course only to guns on which the pistol-grip is secured to the gun itself. With guns in which the pistol-grip is not attached to the gun, but to some part of the mount, it is of great benefit to the pointer in directing his gun, and therefore should in such cases always be used in preference to the lanyard.

317. **In aiming the gun**, always make the necessary correction for wind and speed with the deflection scale, and then aim directly at the target. Consistent hitting is impossible when aiming at some non-defined spot "off the target."

DRILLS FOR SECONDARY- AND MACHINE-GUNS.

DRILL FOR 3-INCH, 50-CALIBER, RAPID-FIRE GUN.

(With training-gear.)

[293 to 298]

(See also notes applicable to 4- and 5-inch rapid-fire guns.)

NOTE.—When directing-bar mount is used, the trainer is unnecessary. The same drill may be used with five men in the crew.

318. ~~3-inch gun~~ Gun-crew.

Title.	Station.
Plugman (acting gun-captain).	At operating-lever.
Pointer.	At elevating-wheel.
Trainer.	At training-wheel.
Sight-setter.	At pointing-wheel.
1st-shellman.	Left and rear of breech.
2d-shellman.	Left and rear of breech.

Cast Loose and Provide!

[20 to 32]

319. (1) The whole crew cast off gun-lashings and clear away port-shutters.

(2) **Plugman** commands; sees gun and mount in working order [29]; supervises all tests; sees accessories and spare parts at hand [109]; examines breech-mechanism [27; 29; 51, (9)] and bore of gun; reports to officer of division when all is ready [300].

NOTE.—The chamber and bore should be examined for burrs, the extractor examined to see that it is intact and is not burred; see that the bore is perfectly clear and that the tompon is removed.

(3) **Pointer** provides and connects firing-attachments; tests firing-mechanism; tests elevating-gear [29, (2)]; at night provides and connects battle-lantern.

(4) **Trainer** places training-sights; tests training-gear [29, (2)].

(5) **Sight-setter** provides all sights; places pointing-sight; provides material for cleaning lenses [28, 84]; at night sees electric connections for night-sights made [95].

(6) **1st-shellman** provides two pairs of loader's-gloves and gives one pair to 2d-shellman; provides box of cartridges and opens it; gets shells ready for loading [24, 41, 42, 43, 44, 45, 46].

(7) **2d-shellman** removes tompon [22], muzzle-bag, and slacks securing-clamps; assists 1st-shellman to provide box of cartridges and prepare them for loading [41 to 46; 302].

(8) **Gunner's-mate** provides tourniquets, fine half-round files, bore- and chamber-sponges, spare parts, case-extractor, waste, bag of sand; issues material for cleaning lenses [109].

NOTE.—The spare parts, which would be provided only at general quarters, target-practice or in action, should consist of the following: Firing-pin, extractor, firing-attachment, wrenches, and screw-drivers.

Load!

[32 to 52].

(The gun having been fired.)

320. (1) **Pointer** keeps gun trained on target.

(2) **Trainer** keeps gun trained on target [38]; sets training-sights [94].

(3) **Sight-setter** sets sight [93].

(4) **Plugman** opens breech.

(5) **1st-shellman** removes empty case and throws it overboard, or lays it to one side, and takes another cartridge [41, 45, 46].

(6) **2d-shellman** places cartridge in gun and stands by to take out empty case after gun has been fired [41].

NOTE.—(a) In loading, the shell should rest in the left hand and the hand be placed in the screw-box to guide the shell into the chamber, being careful not to burr the chamber or screw-box. With the right hand, fist closed, push the cartridge home smartly until it takes against the extractor.

(b) When using shrapnel, shellmen set fuses.

(7) **Plugman** closes breech and taps, or otherwise signals to, pointer when gun is ready.

Commence Firing!

[52 to 60]

321. (1) **Pointer** keeps gun pointed on target continuously and fires when ready.

(2) **Trainer** keeps gun trained on target continuously; sets training-sight [54, 94].

(3) **Sight-setter** sets sight; verifies setting of sight after each fire [93].

Cease Firing!

[60, 61, 62]

322. (1) The service of the gun ceases at this command.

(2) **Plugman** opens breech; closes it when cartridge has been withdrawn.

(3) **Shellman** withdraws cartridge and places it with unused ammunition; if the gun has just been fired, withdraws empty case and puts it with others.

Unload!

[63]

323. This command is given with R. F. guns using fixed ammunition when the gun is loaded and it is desired to unload before the command COMMENCE FIRING! The gun is then unloaded as in CEASE FIRING!

Secure!

[64]

324. The members of the crew secure what they cast loose and return what they provided. After practice they all assist, under the direction of the gunner's-mate, in cleaning the gun [130]. They form for muster after securing [14, (4); also Plate 3, page 24].

DRILL FOR 3-PDR. AND 6-PDR. R. F. GUNS.

(Hotchkiss or Driggs-Schroeder.)

325.

Gun-crew.

Title.	Station.
1st-Pointer.	At shoulder-piece.
2d-Pointer (sight-setter).	At sight.
Plugman (acting gun-captain).	At operating-lever.
Loader.	On side opposite sight, in rear of breech.
Shellman.	At ammunition-box, near breech.
Shellman.	At ammunition-box, near breech.

Cast Loose and Provide!

326. (1) **1st-pointer** removes gun-cover and tompion; casts adrift gun-lashings; ships shoulder-piece; removes drill-hook, if at target-practice or in action, and hooks up spring; tests breech-mechanism; examines bore; takes station at shoulder-piece.

NOTE.—(a) In Driggs-Schroeder guns he removes the drill-washer instead of the drill-hook.

(b) If the gun is mounted aloft, he goes aloft with the **2d-pointer** and the plugman, and sends down the whip for the ammunition and other articles which are whipped up by the loader and shellmen.

(2) **2d-pointer** removes sight-covers; places sights, and sees all in working condition.

(3) **Plugman** commands; provides and examines the reserve-box, containing accessories; sees in place the bore bristle-sponge; unclamps pivot- and cradle-clamps and then reclamps them; sees mount in working order; adjusts drill-apron, when used, and takes station at the operating-lever after reporting to division-officer [300].

(4) **Loader** provides a bucket of fresh water and one hand-swab; takes station to the left and rear of breech, facing it.

(5) **Shellman** brings ammunition from hoist [302] and takes station at ammunition-box in rear of gun.

(6) **Gunner's-mate** provides accessories and spare articles necessary to the service of the gun [312, 313]; provides fine, half-round file and emery paper to remove accidental burrs.

Load!

327. (1) **1st-pointer** places shoulder to shoulder-piece, seizes handle with hand, and as soon as the gun is unclamped, lays it outboard in the direction of the target; plants feet firmly on the deck to resist the motion of the ship.

(2) **2d-pointer** sets sights for the range given, and makes the lateral adjustments as directed.

(3) **Plugman** unclamps pivot- and cradle-clamps as soon as the 1st-pointer has his shoulder to the shoulder-piece; opens breech; as soon as loader has inserted cartridge, closes breech.

NOTE.—(a) The plugman, in closing the breech, sees that the block is fully up, and lets go the operating-lever as soon as the breech is closed. He closes the breech smartly as soon as the cartridge-rim touches the nib of the extractor.

(b) *Loader* takes a cartridge from the shellman, and as soon as the breech is opened, and the empty case clear of the breech-block, places the cartridge in the bore and shoves it home till the cartridge-rim takes against the nib of the extractor.

(c) In loading, the loader stands to the left and rear of the gun; holds the cartridge so as to have the back of the left hand up, grasping the cartridge near the base of the shell; right hand at the base of the cartridge-case, fingers closed, knuckles down; enters the cartridge horizontally in the bore and shoves home smartly. If the rim of the cartridge goes beyond the extractor-nib, removes the extractor, back out the cartridge, replace extractor, and reload.

(d) In inserting the cartridge into Hotchkiss guns, be very careful not to drive the point of the shell against the edge of the chamber. This will not happen if it is pointed horizontally, but it is very liable to do so if the cartridge is pointed downward.

(e) In the case of the Driggs-Schroeder gun, the loader stands to the left and rear of the gun, holds cartridge so as to have the left hand underneath, back down, near the base of the shell; right hand at the base of the cartridge-case, fingers closed, knuckles down, rear end slightly elevated to avoid driving the shell against the upper edge of the chamber. The lower edge and sides are protected respectively by the breech-block and the extractors.

(4) **Shellmen** pass cartridges to loader, and keep the empty cases clear of the gun. When the supply of ammunition is about exhausted, shellman places box near enough to loader to enable the loader to handle shell without leaving position at gun, and shell-men go for a new supply of ammunition.

NOTE.—(a) If in loading, a cartridge-case jams and will not allow the breech-block to close, never attempt to drive it home by forcing the block; unload at once, put it aside, and try another cartridge. Examine powder-chamber for foreign matter; small unburned slivers of powder frequently remain in the bore after firing, particularly when firing to windward. It should not be expected that all cartridge-cases will go home completely without an effort, as the least dirt on the case or in the chamber will prevent this.

(b) Attention is invited to Special Order No. 46 of November 13, 1903, as follows: "As a measure of safety the department directs that force beyond the use of the hand be not used in loading guns using fixed ammunition. If at any time it is found that a cartridge-case does not freely and fully

enter the chamber of the gun, it should be carefully extracted and put aside, to be turned into store at convenient opportunity, being properly marked to indicate its condition."

Commence Firing!

328. (1) **1st-pointer** aims and fires; the gun is reloaded, he fires again, and so on, until command CEASE FIRING! is given, keeping the gun continually on the target.

(2) **2d-pointer** sets sight for the range given, and makes lateral compensations as directed, constantly verifying the rear sight-notch.

NOTE.—With the old type of open sights, the bar jars out after each discharge so that the sight practically has to be reset.

(3) **Loader** loads after each discharge from the side of the gun opposite the sight.

(4) **Plugman** opens the breech after each discharge, and as soon as the cartridge has been inserted in the bore by the loader, closes the breech, and removes his hands from the operating-lever.

NOTE.—(a) If after firing, the cartridge-case sticks after partial extraction, fully extract, and then feel for a burr about the edge of the chamber. If such exists, it must be filed smooth with half-round file. If any dirt is found, it must be removed. This can best be done by providing a stick with a small swab, or sponge lashed to its end. The best preventive of jamming, due to dirt, is to have the shell well wiped off with oily waste before using. When firing small guns to windward, small slivers of smokeless powder frequently remain in the chamber. It is sometimes necessary to clear the chamber by using the small swab on the end of a stick mentioned above.

(b) Under all circumstances if a miss-fire occurs, the pointer firing will sing out "miss-fire," when the crew will stand fast and the division-officer will assume personal direction of the movements of the crew. The plugman must be particularly cautioned not to open the breech [98 to 105].

(5) **Shellmen** pass ammunition to the loader, and keep empty cases clear of the gun.

Cease Firing! or Unload!

329. (1) **Plugman** tightens the pivot- and cradle-clamps and opens the breech slowly. When the cartridge has been removed, he closes the breech and the 1st-pointer pulls the trigger.

(2) **Loader** catches the cartridge with his hand and passes it to a shellman, who places it in the box.

NOTE.—(a) CEASE FIRING! is used after the command COMMENCE FIRING! has been given. UNLOAD! when gun is loaded but fire has not been opened. The same duties are performed at either command.

(b) In the case of the Hotchkiss gun, if the nib of the extractor breaks, back out the stop-bolt sufficiently to clear the breech-block, lower the block until clear of the extractor, pull out the extractor and insert a new one. Do not insert a new extractor with a cartridge in the gun, as the nib will come on the wrong side of the cartridge-rim.

(c) In the case of the Driggs-Schroeder gun, if one extractor breaks, the other one can be used for a time, but the first opportunity should be used to replace the broken extractor; back out the guide-bolt, half cock, draw axial bolt, holding the block by the hand; lower the block far enough to expose the extractor, resting on the upper part of the tray for support; pull out the broken extractor and put in a new one. Do not insert the new extractor with a cartridge in the gun, as the nib will come on the wrong side of the rim of the cartridge.

(3) **Shellman** receives cartridge from loader and replaces it in the box.

NOTE.—Empty cases should be placed in a bucket of fresh water, washed out, and primers knocked out as soon as secured.

Secure!

330. The crews return what they provide, and secure what they cast loose; then take stations for muster [14, (4); also Part I, 39, (4)]. If the gun has been fired they assist to clean, dry, and oil the bore, and clean breech-mechanism.

NOTE.—(a) In the Hotchkiss gun of the old type, the drill-hook is designed to relieve the mechanism from strain when snapping the gun at drill, and also to prevent the firing-pin from delivering too strong a blow when drill-cartridges are used.

(b) At drill, or when the piece is secured, the drill-hook should remain in place. When casting loose for action or target-practice, the drill-hook should be removed, and the lower branch of the main-spring hooked to the stirrup.

(c) In the Driggs-Schroeder gun, drill-washers have been designed to relieve the mechanism, but they should not be kept on when the piece is secured.

DRILL FOR 3-PDR. AND 6-PDR. SEMI-AUTOMATIC GUNS.

(Vickers-Maxim, Driggs-Seabury, and Hotchkiss.)

331. Gun-crew.

Title. Station.

1st-Pointer.	Shoulder-piece.
2d-Pointer (sight-setter).	At sight
Loader (acting gun-captain).	At operating-lever.
Shellman.	Right rear of breech.
Shellman.	Right rear of breech.

NOTE.—The drill for all three types of these semi-automatic guns, Vickers-Maxim, Driggs-Seabury and Hotchkiss, are practically the same. The only change necessary being to have the loader on the side opposite the sight and the 2d-pointer on the same side as the sight.

Cast Loose and Provide!

332. (1) **1st-pointer** removes gun-cover; takes out the tom-pion; unclamps pivot- and cradle-clamps, assisted by loader; then reclamps them; tests breech-mechanism; examines bore, seeing it clear; sees gun and mount in working order; then takes station at shoulder-stock.

(2) **2d-pointer** takes off the sight-covers, or ships sight and sees all in adjustment and working order.

(3) **Loader** commands; provides and examines the reserve-box; sees in place bristle-sponge; assists 1st-pointer in unclamping and reclamping the gun; takes position to the right or left of the breech, facing the rear, in position to receive cartridges from shell-men; when all is ready reports to division-officer.

(4) **Shellmen** bring ammunition from hatch; provide bucket of fresh water, clean hand-swab; take station in rear of loader and alongside ammunition, ready to rapidly pass cartridges to loader, being careful to see that all cartridges are wiped clean with oily waste.

Load!

333. (1) **1st-pointer** keeps stock to shoulder, having previously taken easy and steady position at gun, feet well apart, and keeps gun continuously trained on target.

(2) **2d-pointer** sets sight for range given, and makes adjustments for lateral compensation as directed.

(3) **Loader** opens the breech smartly, if not already open; inserts cartridge and smartly shoves it home with the right hand, following the cartridge with the hand until the rim of the cartridge-head takes against the extractor, thus automatically closing the breech.

NOTE.—(a) Efficient loading will require much drill and practice to acquire the necessary expertness. The loader must be trained to center the cartridge rapidly, and shove home smartly with closed fingers of right hand pressing firmly against head of cartridge, palm of hand toward muzzle of gun, following the cartridge home with the hand.

(b) With the ammunition well cleaned, and careful attention paid to the above details of shoving cartridge home there should be no failure of breech to close. If the breech-block fails to close, withdraw the cartridge, examine for dirt, burrs, or defective ammunition. If nothing is found, make a second trial, shoving home as smartly as possible.

(c) Never under any circumstances use anything but the hand in loading.

(4) **Shellmen** pass cartridges to loader, and keep empty cases clear of the gun; clean cartridges when necessary.

Commence Firing!

334. (1) **1st-pointer** fires when on the target.

(2) **2d-pointer** sets sight for range given, and makes lateral compensation as directed.

(3) **Loader** continues loading, giving his undivided attention to this function.

(4) **Shellmen** pass cartridges to loader. If conditions require the absence of both shellmen to obtain fresh supply of ammunition, when supply is about exhausted, shellmen will place the box near enough to the loader to enable him to handle the shell without leaving his position at the gun. The shellmen go for fresh supply of ammunition.

NOTE.—Premature firing with semi-automatic guns is liable to occur with inexperienced pointers who through nervousness retain a pressure on the trigger after firing.

Cease Firing! or Unload!

NOTE.—The command UNLOAD! is given when the gun is loaded, and before the command COMMENCE FIRING! The same duties are performed at the two commands.

335. (1) **1st-pointer** discontinues the firing, steadies gun until clamped, then stands clear.

(2) **Loader** slowly opens breech; when cartridge has been removed, closes breech by pressing on extractor-nibs with the rammer; clamps gun in elevation and train.

(3) **1st-pointer** snaps the lock.

(4) **Shellman** removes cartridge, wipes clean and replaces it in the ammunition-box.

Secure!

336. Crew return what they provide, and secure what they cast loose; assist to clean the bore, breech-mechanism, etc., and then form for muster. If the gun has not been fired, they form for muster immediately after they have returned what they cast loose [14, (4); also Part I, 39, (4)].

DRILL FOR 1-PDR. R. F. GUN.

(As mounted on board ship.)

337. ~~1st Pointer~~ Gun-crew.

Title.	Station.
1st-Pointer.	At shoulder-piece.
2d-Pointer (sight-setter).	Right, rear of breech.
Plugman (acting gun-captain).	At operating-lever.
Loader.	Left side of gun.
Shellman.	Ammunition-box, near gun.

Cast Loose and Provide!

338. (1) **1st-pointer** removes gun-cover and tompion; unclamps pivot- and cradle-clamps, then reclamps them; tests breech-mechanism; sees gun in working order, and examines bore; when ready takes station at shoulder-piece.

NOTE.—If the gun is mounted aloft, the 1st-pointer goes aloft, sends down whip for ammunition and the other articles provided by the shellman.

(2) **2d-pointer** removes sight-cover, places sight, and sees all in working order.

(3) **Plugman** commands; provides and examines reserve-box, containing accessories; sees in place bristle bore-sponge; takes station at operating-lever, after reporting to division-officer [300].

(4) **Loader** and **shellman** provide bucket containing fresh water and one hand-swab, which they place in bucket; place bucket to rear and clear of gun; provide box of cartridges and place it to left and rear of gun. If gun is mounted aloft, they whip up the articles and ammunition before going aloft; then secure the whip.

(5) **Gunner's-mate** provides fine, half-round file and emery paper (for the removal of burrs that may be accidentally caused around the chamber); provides the other spare articles necessary to the service of the gun [312, 313].

Load!

339. (1) **1st-pointer** places shoulder to shoulder-piece; seizes handle; places gun on target, as soon as it is unclamped; plants his feet firmly on the deck to resist the motion of the ship; follows the motion of the target, keeping "on" all the time.

(2) **2d-pointer** sets sights for range given, and makes lateral adjustment as directed.

(3) **Plugman** unclamps pivot- and cradle-clamps as soon as 1st-pointer has shoulder to shoulder-piece; opens breech; as soon as loader inserts cartridge, closes breech smartly; also loads when loader and shellman are away for ammunition.

(4) **Loader** receives cartridge from shellman, and as soon as the breech is opened, loads from the left side of gun, placing cartridge in the bore until the rim takes against the extractor. When the box of ammunition is about exhausted, he and the shellman go for more ammunition, the plugman loading during the absence of the loader and shellman, thus maintaining a continuous fire.

(5) **Shellman** provides the ammunition, assisted by loader; passes cartridges to loader, and keeps empty cases clear of gun.

NOTE.—(a) In loading, the loader stands on the left side of the gun, holds cartridge so as to have the left hand on top, back of hand up, and near the base of the shell; right hand at the base of the cartridge-case, fingers pressing against upper rim; enters the cartridge horizontally in the bore, and shoves smartly home. The plugman closes the breech as soon as the cartridge-rim touches the extractor-nib.

(b) If the cartridge-rim goes beyond the extractor-nib, remove extractor, back out shell, replace extractor, and reload. If the cartridge sticks, unload and try another; do not attempt to drive it home; all the force necessary in loading, is to swing the block smartly.

Commence Firing!

340. (1) **1st-pointer** aims and fires; the gun is reloaded without any further command; he fires again, and so on, till the command **CEASE FIRING!** is given; keeps gun continually on target.

(2) **2d-pointer** adjusts the sight for the designated range, and makes sure that the lateral compensation is properly made; after each shot he verifies the setting of the sight, seeing that it has not been jarred out by the shock of firing.

(3) **Loader** loads from the left side after each discharge.

(4) **Plugman** opens breech after each discharge, and closes it again after the shell has been inserted in the bore.

(5) **Shellman** passes ammunition to loader, and keeps empty cases clear of the gun.

NOTE.—(a) If, after firing, the cartridge sticks, after partial extraction, fully extract, and feel for a burr around the chamber-edge. Remove burr with half-round file, remove dirt with sponge.

(b) In the guns of the secondary-battery, hang-fires, except with 3-inch R. F. guns, of any considerable duration, are infrequent. Under any circumstances, if a miss-fire occurs, the pointer firing will sing out "miss-fire" when the crew will stand fast, and the division-officer will assume personal direction of the movements of the crew [98 to 105].

Cease Firing! or Unload!

341. (1) **Plugman** tightens the pivot- and cradle-clamps; opens the breech slowly; when the cartridge has been removed, closes the breech and pulls the trigger.

(2) **Loader** catches the cartridge in the right hand, and passes it to the shellman.

(3) **Shellman** receives the shell from the loader, and replaces it in the box.

NOTE.—(a) After firing, the cases should always be filled with fresh water and then emptied before sending below, as a residual gas of dangerous character remains in the case, and should be entirely expelled.

(b) In the Hotchkiss gun, if the nib of the extractor breaks, back out the stop-bolt sufficiently to clear the breech-block, lower the block until it is clear of the extractor; pull out the extractor, and insert a new one. Do not insert a new extractor with a cartridge already in the gun, as the nib will come on the wrong side of the rim of the cartridge-case.

Secure!

342. The crew return what they provided and secure what they cast loose, then take stations for muster. If gun has been fired, the crew assist to clean and oil before forming for muster [14, (4); also Part I, 39, (4)].

NOTE.—(a) The ammunition-supply for guns mounted in the tops is generally precarious, and, in case of emergency, the division-officers must see that provision is made that all the ammunition that can be stowed without interfering with the efficient working of the guns, is hoisted to the tops.

(b) After ammunition-boxes have been sent below, and before stowing them in the fixed-ammunition magazines, the men stationed there will re-distribute the ammunition, so as completely to fill all the partly filled boxes except one. This last partly filled box should never be sent on deck in providing.

DRILL FOR 1-PDR. MAXIM-AUTOMATIC GUN.

343.

Gun-crew.

Title.

Station.

1st-Pointer.	At shoulder-piece.
Loader (2d-pointer and sight-setter).	At right of gun.
Shellman.	At left of gun.
Shellman.	At left of gun.

NOTE.—The man who is acting as loader, whether 1st- or 2d-pointer, also acts as gun-captain.

Cast Loose and Provide!

344. (1) **1st-pointer** removes gun-cover; takes out tompion; tests the mechanism, noting that the spring is under sufficient tension; that the gun-jacket is filled with cold water, and that the mount generally, including the elevator, is in working order; un-clamps the gun; then reclamps it and takes station at shoulder-piece.

(2) **Loader (2d-pointer)** commands; provides and examines the reserve-box [314]; removes sight-covers, or ships sights, and sees all in adjustment; takes station at the right of the gun; when gun is ready, reports to division-officer [300].

(3) **Shellmen** alternate in supply of ammunition from hatch and place it in rear of gun; take station alongside of ammunition; examine boxes and ammunition, and see that the belts are properly filled and clear.

Load!

345. **Shellman** delivers box containing filled belt of ammunition to loader; goes to the left side of the gun; pulls the belt, when it is pointed through the feed, until the carrier has placed one cartridge in the bore and seized another.

NOTE.—Loader receives the filled belt of ammunition from shellman; ships it in place on the right side and opens it; picks up the end of the belt, enters it fairly in the feeding aperture and passes it through to the shellman; works twice, smartly through its full throw, the hand-lever on the right side of the gun in order to cause the carrier to seize and place one cartridge in the barrel and to seize another; sets sights for range given and makes lateral compensation as directed.

Commence Firing!

346. (1) 1st-pointer fires when ready, by pulling the trigger.

NOTE.—(a) For continuous fire, he retains his pull on the trigger, first setting safety-indicator at automatic position.

- (b) For single shots he releases the trigger after each fire, first setting the safety-indicator at the single shot position.
- (c) In the later type of guns, the indicator has but two positions; viz., "safety" and "fire."
- (d) 2d-pointer sets sight at range indicated and makes lateral adjustments as ordered.

(e) Receives boxes containing filled belts from shellman. As the last cartridges of a belt start from the box on the gun, unships the empty box and ships a new one, following the old belt closely with the end of the new one, and proceeds as in LOAD!

- (2) **Shellman** starts each new belt by pulling it through the loading aperture, working on the left side of the gun; keeps belt in hand and guides it as necessary until ammunition is exhausted; shellman passes box containing filled belts to loader and goes for a fresh supply.

NOTE.—Shellman will seize the belt as in first motion of load, and will continue the pull on the belt to assist the feed-box claw, until the weight of the belt on the left side of the gun is sufficient to assist the claw to shift the belt to the left after each discharge. This is not generally necessary for more than half a dozen shots.

Cease Firing!

- 347. (1) **1st-pointer** steadies the gun until clamped; sets safety-indicator at "Safety" position.

- (2) **Loader** tightens clamps.

Unload!

- 348. (1) **Loader** holds the belt with the right hand to prevent feeding; works twice, smartly through its whole throw, the lever on the right side, thus placing two loaded cartridges in the ejecting-tube below the gun; withdraws the partially filled belt and lays it, clear for running, in the box; receives from shellman the two cartridges placed in the ejecting-tube, wipes them clean, places them in belt-box, closes box, unships it and passes it to the shellman.

- (2) **Shellman** removes the loaded cartridges from the ejecting-tube below the gun, and passes them to the loader; gathers up the empty shells and places them in their boxes; receives the box containing the partially filled belt from loader; sees that the boxes containing filled belts, partly filled belts, and empty belts are separated.

- (3) **1st-pointer** pulls the trigger, snapping the lock.

NOTE.—Never leave the gun with a cartridge in it. The officer in charge of a machine or automatic gun will always assure himself by personal inspection that all cartridges are out of the gun and its mechanism.

Change Stations!

349. 1st- and 2d-pointer change stations.

Secure!

350. The crew will return what they provided and secure what they cast loose; assist to clean gun if necessary; then form for muster [14, (4); also Part I, 39, (4)].

NOTE.—(a) The Maxim-Automatic 1-Pdrs. have given considerable trouble, and frequently fail to fire an entire belt automatically. This is generally due to one of the following reasons:

(1) The cases are imperfectly crimped to the shell, causing them to pull apart when carrier seizes the rim of case.

(2) Buffer-cylinder too full.

(3) Lever has been operated only once, which loads gun, but does not cause the carrier to take hold of a second cartridge.

(b) Before firing, the cartridges should be carefully examined, and only well-crimped ammunition used.

(c) The cartridges should then be carefully examined to see primers are flush with base and not too deeply set in their seat. They should be thoroughly cleaned and wiped off with a lightly oiled rag.

(d) They should be inserted in belt perfectly even, and a little further in than present instructions prescribe. This gives them a good snug fit in the belt, which is very necessary. With cartridges which are shoved in far enough to have a sufficiently tight fit, well-crimped ammunition is very necessary, otherwise the necessarily tight fit will cause the case and shell to pull apart.

(e) The buffer-cylinder should be from one-half to three-fourths full, as prescribed above. It is necessary to assist the mechanism, especially for the first few shots, by pulling the belt through.

DRILL FOR 37 M/M HOTCHKISS REVOLVER-CANNON.

351. Gun-crew.

Title.	Station.
1st-Pointer.	At shoulder-piece.
2d-Pointer (sight-setter).	Right of breech.
Loader (acting gun-captain).	Left side of gun.
Shellman.	Ammunition-box, near gun.

Cast Loose and Provide!

352. (1) **1st-pointer** removes gun-cover; tests gun-mechanism by revolving firing-crank; sees gun in working order; examines bores; adjusts drill-apron, if used; when ready takes station at shoulder-bar.

NOTE.—In case of a gun mounted aloft, the 1st-pointer goes aloft and sends down whip for ammunition and other articles provided by shellman.

(2) **The 2d-pointer** removes sight-cover; ships sight; sees it in working order; slacks and tests gun-clamps; provides accessory-box.

(3) **Loader** commands; provides and ships feed-box; provides hand-swab and bucket of fresh water; assists shellman with ammunition; when ready, reports to division-officer.

(4) **Shellman** brings ammunition from hoist. If gun is mounted aloft, shellman whips up articles before going aloft.

(5) **Gunner's-mate** provides file and emery paper (for removal of burrs); provides all accessories and spare parts necessary to the service of the gun.

Load!

353. (1) **1st-pointer** places shoulder to shoulder-bar; seizes handle with left hand and firing-crank with right hand; lays gun on target as soon as it is unclamped; places feet firmly on the deck to resist the motion of the ship; follows the motion of the target, keeping "on"; moves firing-crank until the first loaded barrel has reached the firing position.

(2) **2d-pointer** unclamps when 1st-pointer has gun under control; sets sights for range given, and makes lateral adjustments as directed.

(3) **Loader** receives ammunition from shellman, and places cartridges in hopper (of feed-box), keeping the hopper full.

(4) **Shellman** provides ammunition; passes cartridge to loader and sees empty cases clear of gun. When box is nearly finished, shellman places ammunition at hand near loader and goes for another box. For a top gun, extra ammunition must be provided and whipped up by powder-division or special-detail.

Commence Firing!

354. (1) **1st-pointer** aims and fires; keeps gun on target and continues fire when sure of aim; continues until command **CEASE FIRING!** is given.

(2) **2d-pointer** continues adjustment of sight, as directed; makes sure after each shot that sight has not jarred out or down.

(3) **Loader** continues filling hopper as the firing proceeds.

(4) **Shellman** passes ammunition to loader.

NOTE.—(a) If cases stick, investigate for burrs, which must be removed by file.

(b) In case of a miss-fire wait 20 minutes for a hang-fire, then feed on through, receiving shell in hand. It will be at once apparent whether the miss-fire was due to faulty ammunition or firing-pin. In case of broken firing-pin, open breech and remove the broken pin and insert new one.

(c) In guns of the secondary-battery, excepting 3-inch, hang-fires of any considerable duration are infrequent. Under any circumstances if a miss-fire occurs, the pointer firing will sing out "miss-fire," when the crew will stand fast and the division-officer will assume personal direction of the movements of the crew [98 to 105].

Cease Firing!

355. (1) At the command **CEASE FIRING!** the service of the gun ceases.

(2) **Loader** takes out firing-pin.

(3) **2d-pointer** tightens clamp.

(4) **1st-pointer** stands clear.

Unload!

356. (1) **Loader** takes out firing-pin.

(2) **2d-pointer** tightens clamps, with gun level and pointing clear.

(3) **1st-pointer** revolves firing-crank slowly and the loader receives the cartridges by hand until all the chambers are empty.

(4) **Loader** passes cartridges to shellman, who replaces them in the box.

NOTE.—(a) *Never leave the gun with a cartridge in it.* The officer in charge of a machine- or automatic-gun will always assure himself by personal inspection that all cartridges are out of the gun and its mechanism.

- (b) If cartridge-case does not extract, it must be forced out from muzzle when in extract position.
- (c) In returning ammunition, care must be taken that empty cases are not replaced in boxes containing loaded shells.
- (d) The extractors of these guns frequently break and should be looked out for.

Change Stations!

357. The 1st- and 2d-pointer will change stations. Also, for the purpose of drill, the change of station should continue through the crew, in order to familiarize them with the drill of each station.

Secure!

358. The crew return what they provided and secure what they cast loose; then take stations for muster. If the gun has been fired, crew assists to clean it before forming for muster [14, (4) also Part I, 39, (4)].

NOTE.—(a) The ammunition-supply for the guns mounted in the tops is generally precarious, and in case of emergency the division-officers must see that provision is made that all the ammunition that can be stowed without interference with the efficient working of the guns, is hoisted into the tops.

(b) After ammunition-boxes have been sent below and before stowing them in the fixed-ammunition magazines, the men stationed there will re-distribute the ammunition, so as completely to fill all the partly filled boxes except one. This last partly filled box should never be sent on deck in supplying ammunition.

DRILL FOR A GATLING-GUN.

(Mounted on board ship or in a boat.)

359.

Gun-crew.

Title.

Station.

Pointer.

Rear of gun, right of breech.

Crankman (2d-ptr., actg. gun-capt.)

At operating-crank.

Loader.

On left of breech, at feed.

NOTE.—The man who is acting as crankman, whether 1st- or 2d-pointer, also acts as gun-captain.

Cast Loose and Provide!

(Guns secured for sea.)

360. (1) **Pointer** removes gun-cover; ships pointing-lever, if used; places sight; tests mechanism; sees mount in working order; sees in place the gear and implements for the service of the gun; takes station in rear of gun at pointing-lever; if the gun is mounted aloft, goes aloft; sends down whip for ammunition and other articles; receives articles whipped up by the crankman and loader.

(2) **Crankman** commands; sees crank ready for use; provides reserve-box; assists loader to bring ammunition; takes station on right of breech at operating-crank; when all is ready, reports to division-officer.

(3) **Loader** sees gun clear for feeding; brings ammunition from hatch, assisted by the crankman; takes station on left of breech at feed.

NOTE.—If the gun is mounted aloft, the crankman and loader whip the articles and ammunition to the top before going aloft, and then secure the whip and net under the top.

Load!

361. (1) **Pointer** places himself at the pointing-lever, and, as soon as gun is unclamped, lays it in the direction of the target; plants his feet firmly on deck to resist the motion of the ship.

(2) **Loader** takes filled feed-case from box and ships it in position on the piece; gets another feed-case ready for shipping. When only two feed-cases remain, loader calls out "Shell" and goes for more ammunition.

(3) **Crankman** loosens the horizontal and vertical clamps; partially turns the crank to work down the cartridges to a point short of the firing position; performs the duties of loader during his absence.

Commence Firing!

362. (1) **Pointer** adjusts the sight for the designated range, aims, and commands FIRE!

(2) **Crankman** turns the crank at command of pointer, working it slowly until range is well determined.

(3) **Loader** attends the feed, and supplies fresh feed-cases.

NOTE.—If loader requires assistance in bringing ammunition, it must be rendered by crankman.

(4) The firing is continued until the command CEASE FIRING! is given.

Cease Firing!

363. Service of gun ceases. Crankman clamps gun. Pointer stands clear, places firing-pin out of action.

Unload!

364. (1) **Pointer** steadies the gun for clamping, if not already clamped.

(2) **Loader** removes feed-case, catches loaded cartridges as they drop out of the gun, replaces them in the case, and returns case to the box.

(3) **Crankman** clamps gun, if not already clamped; throws back hopper, turns crank backward slowly, and withdraws cartridges; then turns crank to see that no cartridges remain in the barrels; or by special direction, the cartridges in the barrel may be fired. *The piece must not be left loaded*, nor with a cartridge in its mechanism, the officer of the piece making a personal inspection to this end.

Change Stations!

365. (1) To be used frequently at drill in order to familiarize the men with all the duties at the gun.

(2) At this command the pointer and crankman change stations.

Secure!

366. The members of the crew return what they provided, and secure what they cast loose; then form for muster [14, (4); also Part I, 39, (4)].

As Riflemen!

367. If, during action, the piece jams permanently, or is otherwise disabled beyond immediate repair, the crew is called away as riflemen. At this command they put on the belts and arm themselves with rifles, and, when ordered, open up a rapid fire at the enemy.

NOTES ON THE GATLING-GUN.

368. The adjustment of the throw of firing-pins should be attended to by the officer of the piece, and is accomplished by turning the adjusting-nut. The indentation of the cap by the firing-pin and the "feel" of the crank will guide him in this matter. A normal mark is placed on the adjusting-nut, but this is not absolute. After prolonged firing the parts become hot, and the nut should then be eased a little to compensate for the expansion, if there is a prospect of continued firing.

369. To cool the barrels.—They may be readily cooled by pointing muzzle to wind, with hopper thrown open.

370. Disabled lock.—This accident need not interrupt the fire; change the lock, if there is time; if not, withdraw it and there is but the loss of fire from the corresponding barrel.

371. Jammed cartridge.—This often happens when very rapid fire is attempted, or when parts are much worn. If a cartridge jams, reverse the crank slowly, then try ahead slowly; it will sometimes go smoothly, but if it continues to jam, raise the hopper, reverse the crank slowly, throw out the jammed cartridge, close the hopper and continue the firing. If a cartridge-head is pulled off, leaving the cartridge-shell in the bore, the next cartridge which enters that barrel will jam; if this is the cause of the accident to the piece, use a shell-extractor and rammer to remove the shell, or remove lock. If rammer is used, great care is necessary to insure that all barrels except the one in question are unloaded. In action always remove lock and continue the fire.

DRILL FOR A COLT-AUTOMATIC GUN.

Mounted on board ship or in a boat.

372. Gun-crew.

Title.	Station.
Pointer.	In rear of gun.
1st-Loader (2d-ptr., actg. gun-capt.)	On left of gun.
2d-Loader.	In rear of 1st-loader.

NOTE.—The man who is performing the duties of 1st-loader, whether 1st-or 2d-pointer, also acts as gun-captain.

Cast Loose and Provide!

373. (1) **Pointer** commands; removes gun-cover, if gun is kept mounted; otherwise brings case containing gun and, assisted by 1st-loader, mounts the gun; tests mechanism by throwing back gas-lever, letting it go, and pulling the trigger; sees the bore clear; sees mount in working order; takes station in rear of gun. If the gun is mounted aloft, pointer goes aloft; sends down whip for ammunition and other articles; receives articles whipped up by 1st-loader and 2d-loader.

(2) **1st-loader** commands; if gun is not mounted, assists pointer to bring case containing the gun, and then mounts the gun; assists 2d-loader to bring ammunition; takes station on left side of gun; when all is ready, reports to division-officer.

(3) **2d-loader** provides ammunition and places it on deck to the left and to the rear of the gun; takes station at the ammunition-boxes; if the gun is mounted aloft, 1st-loader and 2d-loader whip the articles and ammunition to the top before going aloft, and then secure the whip and net under the top.

Load!

374. (1) **Pointer** grasps the pistol-grip and as soon as the gun is unclamped, lays it in the direction of the target; plants his feet firmly on deck to resist the motion of the ship.

(2) **1st-loader** loosens clamps; ships box containing the ammunition-belt on left side of the mount and enters end of the belt in the loading-slot; throws back the gas-lever smartly to its full extent and releases it, noting that the belt is held, a cartridge withdrawn, and that the gas-lever is closed; sees that the belt feeds fairly; performs the duties of 2d-loader during his absence.

(3) **2d-loader** passes box containing ammunition-belt to **1st-loader**, and when necessary goes for more ammunition.

Commence Firing!

375. (1) **Pointer** adjusts the sight for the designated range; grasps the pistol-grip firmly with both hands, aims, presses the trigger with forefinger of right hand, and continues the fire until the command **CEASE FIRING!** is given.

(2) **1st-loader** ships new boxes containing ammunition-belts, when necessary; enters the belt fairly into loading-slot, taking care not to touch the hot barrel with his hands.

NOTE.—A slight tension on the belt, from left side, helps it to feed fair and smoothly, and prevents jamming.

Cease Firing!

376. (1) **1st-loader** clamps piece.

(2) **Pointer** pushes knurled head to safety-position.

Unload!

377. (1) **Pointer** presses back the knurled head on the right side of gun.

(2) **1st-loader** clamps piece, if not already clamped; withdraws ammunition-belt; throws back gas-lever smartly and ejects unfired cartridge; releases the gas-lever and replaces cartridge in the belt; unships box and hands it to **2d-loader**.

(3) **2d-loader** takes box from **1st-loader** and coils the ammunition-belt clear for running; places cover on box.

(4) **Pointer** pulls the trigger, snapping the lock.

NOTE.—*The piece must not be left loaded, the officer of the piece will make a personal inspection to this end.*

Change Stations!

378. (1) To be used frequently at drill in order to familiarize the men with all the duties at the gun.

(2) At this command the **1st-** and **2d-pointer** change stations.

Secure!

379. The members of the crew return what they provided and secure what they cast loose, and then form for muster.

As Riflemen!

380. If during action the piece jams permanently, or is otherwise disabled beyond immediate repair, the crew are called away as riflemen. At this command they put on the belts and arm themselves with rifles and, when ordered, open up a rapid fire at the enemy.

NOTES ON THE COLT-AUTOMATIC GUN.

381. (1) Attention is invited to the description of the Colt-Automatic Gun issued by the Bureau of Ordnance. A brief of this description, in so far as it relates to care, handling, and probable accidents, is incorporated in Part V of this book.

(2) Success with this gun can be obtained only by a perfect knowledge of the mechanism, and of the precautions to be observed in its use. This is exemplified by the recent great improvement which has been attained throughout the service since regular practice with these guns has been carried out.

(3) By far the most common cause of an interruption of automatic fire has been found to be due to a *jam in the feed*. This is sometimes due to a cartridge fitting too tightly in its pocket in the belt, so that the cartridge-extractor cannot draw it out. This is frequently caused by the belt being damp. Jam in the feed is, however, more frequently due to uneven loading of the belt. Even machine-loaded belts are not always loaded with sufficient evenness to fire a complete string. After the belt is loaded it should be stretched out along the deck and the bases of cartridges should be made perfectly even by use of a straight-edge. Jams in the feed can usually be cleared through the hole in the right side-plate.

(4) (a) In general, when a jam or stoppage occurs, due to any cause, the first thing to do, after waiting long enough to see that it is not a hang-fire, is to release the trigger, then work the gas-lever gently by hand, observing the mechanism meanwhile to see what the cause of the stop is. Jammed cases or cartridges may be removed through the ejection-opening with the blade of a knife or the point of a screw-driver.

(b) Occasional, slight hang-fires have been observed with the Colt-automatic gun, hence in case of a miss-fire at least ten seconds should be allowed to elapse before removing cartridge.

(5) A wooden operating-handle is provided, among the acces-

sories, which may be slipped over the gas-lever pin, for operating the lever when the gun is hot.

(6) **The only cautions that need be observed** are these:

(a) If the gun stops with the lever closed, wait two or three seconds to see if a hang-fire has occurred.

(b) If the gun is very hot, as after continuous firing for three or four minutes, release the belt and draw it out an inch or two to the left, then work the gas-lever, emptying the chamber.

(c) Always, in operating the lever by hand, do so slowly; observing the action of the mechanism meanwhile, and do not attempt to clear any jams by force.

(d) In loading belts, see that the cartridges are all pushed well home in the loops and that their bases are perfectly even, if possible lining them up with a straight-edge.

Aiming and Firing.

382. (1) The gun being very light and easily trained in any direction, it should always be fired with clamps loose and directed by the firing hand; it will be found that, with a little practice, it is easy to handle the gun and direct the stream of bullets on any object.

(2) In firing at a fixed target from a fixed platform, the gun may be carefully sighted and then clamped. In rapid firing, the gun will "throw" up slightly and the shots will strike a little higher than in single-shot firing.

Spare Barrels.

383. (1) With each gun is issued a spare barrel, which has been carefully fitted to the receiver and given the same number as the gun to which it belongs.

(2) To replace a barrel, the gun is entirely dismounted and the barrel placed in a strong vice, when the receiver may be unscrewed by the use of a heavy monkey-wrench (a 24-inch or 36-inch wrench should be used); the new barrel is then entered and screwed home until the "qualifying mark" on its lower side registers exactly with the corresponding mark on the lower face of the receiver.

(3) The life of a barrel has been found to be about 9000 rounds.

SALUTING.

384. (1) The characteristics of a saluting vessel are laid down in the U. S. Navy Regulations.

(2) No salute will be fired with less than four guns (of the type used in saluting) being cleared away ready for firing. Two of these guns will be on each side, and they should preferably be adjacent to each other. Two of these guns will be auxiliary and two, one on each side, used for the salute. Neither top guns, nor guns larger than 6 inches in caliber, will ever be used for saluting, except on the especial occasions prescribed in the U. S. Navy Regulations.

(3) The gunner of the ship, the ordnance officer, or in their absence some other officer, will give the necessary commands for firing. Before commencing the salute he is to assure himself that the pointers of the guns about to be fired clearly understand the order of firing, and in giving the commands for firing he is to be within sight and easy hearing distance of the gun. He will regulate the time interval and count the guns.

(4) The guns employed are to be manned either by the gunner's gang, by their own crews, or by a crew of a similar gun, so that there may be no want of acquaintance with the drill.

(5) A specially selected man is to be stationed at the auxiliary saluting gun on each side of the ship, to fire in case the regular gun on that side misses fire. The auxiliary saluting guns will be loaded but breech-plug left open, and the men stationed at them will each closely watch the regular saluting gun on his own side, and the instant he perceives a miss-fire from the regular gun he will close the breech and be ready to fire when ordered by the saluting officer.

(6) In ships in which a choice is possible, such guns are to be chosen as facilitate the above instructions being carried out.

385. (1) The procedure in firing a salute will be as follows:

(2) The guns will be cast loose and prepared for firing at the call "Saluting gun-crews to quarters."

(3) When ready, the officer firing the salute will command LOAD! at which the two regular guns will come to "ready." The auxiliary guns will load, leaving the plug open, and the designated man will take his station at the gun.

(4) The guns will fire in succession, first starboard, then port, by order of the officer, who will give his orders thus: "I—FIRE!;

2—FIRE! ; 3—FIRE!" etc. The interval between shots will be from 5 to 10 seconds, as may be directed.

(5) After firing, each gun will reload and stand by to fire at the command.

(6) On completing the required number of "guns," the officer firing the salute will command CEASE FIRING! UNLOAD! and will report to the officer of the deck that so many "guns" have been fired.

(7) The officer of the deck should always sound SILENCE! before firing the salute, and CARRY ON! after it is completed.

(8) When using small R. F. guns, in case of a miss-fire the breech will not be opened for 20 minutes. If the gun can be re-cocked, the crew of the regular gun will recock it and it will be tried on the next shot fired from that side, the auxiliary-gun standing by as before. If it again fails to fire, it is thrown out of the salute.

PART III

EMERGENCY-DRILLS

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EMERGENCY-DRILLS.

GENERAL REMARKS.

1. The following are included under the head of emergency-drills: Collision-drill, abandon-ship, fire-drill, general-quarters, and fire and rescue parties.

2. (1) **Signals.**—The general-alarm gongs located throughout the ship, together with the solenoid-whistles, when fitted, are the emergency-signals. The sounding of the general-alarm gongs indicates that a call will follow which requires every man to go immediately to his station. The call which follows the general-alarm indicates the nature of the exercise. The general-alarm, therefore, simply calls every man's attention to an "all hands" signal which is to follow.

(2) **Ship's station-bills** indicate the detailed duties of the various men at each of the above-mentioned exercises; but, as the U. S. Navy Regulations require certain duties to be performed, regardless of the absence of certain men who may be specially stationed to perform them, the general duties under each heading are given below.

(3) **Arms.**—At all emergency-drills, officers are armed with service belt and revolver. No sword will be worn.

3. **Marines.**—At collision-drill, fire-drill, and abandon-ship, marines will be stationed at the boat-falls with orders not to allow a boat to be lowered except by order of a commissioned officer.

COLLISION-DRILL.

4. **Signals.**—An efficient signal, audible throughout the ship, is provided as a signal to close watertight doors, hatches, and valves. When sounded, whether it is preceded by the general-alarm or not, it is a peremptory order for every officer and man to go to his assigned station with all practicable speed, and for every watertight door, hatch, air-port, trap and valve in the ship to be closed as quickly as possible.

5. (1) **Stations.**—Individual men will be permanently detailed for each door, valve, and hatch; and on hearing this signal, they will at once proceed with all practicable speed to perform their assigned duties, and when they are performed, report to their division-officer at a previously designated place.

(2) A sufficient number of men will be so detailed as to provide for all possible absentees. Men will remember that individual stations are assigned them only for reasons of expediency, and they must understand that the work allotted to each division must be done as quickly as possible. It is therefore the duty of each man, after completing his assigned duties, to assist in performing other necessary work, which, owing to absence or other cause, may not have been performed. At each drill, care must be exercised that every door is closed and clamped as securely as in case of actual collision. Defects noted by any man which interfere with the efficient closing of doors, etc., must be reported at once to his division-officer.

(3) The division-officer will assure himself before he reports ready, that all precautions have been taken, and all work required within the limits of his division has been efficiently performed.

(4) After the completion of the duties assigned, men will fall in at quarters, or at other designated stations.

6. (1) **Precautions.**—Men will be stationed to close watertight doors and hatches in succession on each line, beginning with interior ones. Men stationed to close exterior outlets will acquaint themselves with the name and personality of each man, who, after closing interior doors, is to pass out by their station; and great care will be exercised that all persons below have passed up before the exterior outlets are closed.

(2) At sea, and in port in foggy weather, as many watertight doors and valves as practicable should be closed.

(3) When signal is given to close watertight doors, the valves in ventilator-conduits must always be closed, unless they are automatic.

(4) Branch pipes from air-conduits to the magazines and shell-rooms will be kept disconnected, except when the latter are in use.

7. **Collision-mat.**—A detail of men, designated by the station-bill, will prepare the collision-mat for use; and at drills will actually place it, whenever practicable, over the supposed hole. The position of the supposed hole will be varied at different drills. In order that men may be practiced at their positions to act promptly and perform their duties without confusion, there will be frequent exercises with the collision-mat without previous warning, and the time required for the full evolution will be entered in the log.

8. **Bulkheads.**—The station-bill will provide for details of men to shore up and make secure the bulkheads of flooded compartments,

9. Weekly tests.—Once each week all cocks, valves, slides, doors, outlets and hatches in connection with the ventilating apparatus, pumps and watertight compartments, will be examined and worked.

10. Inspections should be critical in their nature, the consideration always being "*Is the ship in all respects as well prepared against the effects of collision as could be desired.*" Occasional inspections should determine, by the use of chalk on gaskets, whether watertight doors are properly closed.

11. Save property.—The officers and men who in fire-drill and abandon-ship are required to save the log, records, money, valuable papers, etc., will, at the signal for collision-drill, make preliminary preparations for this duty.

12. Surgeon's-division.—Similarly the surgeon's-division will make necessary preliminary preparations for saving the sick; and the master-at-arms, stand by to release prisoners.

13. Engineer-department.—The following general duties will be performed in the engineer-department:

- (1) Engines will be handled by signal from deck.
- (2) Man all machinery, main and auxiliary, in engineer-department.
- (3) Tend signal-gear.
- (4) Tend steering- and capstan-engines.
- (5) Close doors and valves in all compartments except such doors as are required for men to escape. Tend the latter so they can be closed instantly.
- (6) Tend main-drain valve and connection to fire-, bilge-, and circulating-pumps.
- (7) Tend valves on berth-deck.
- (8) Sound and pump bilges in all compartments.
- (9) Get all boilers that can be used ready for lighting fires; and, if at anchor, make preparations for getting under way.
- (10) Open necessary valves for pumping flooded compartment with all pumps.

14. General instructions.—The signal for closing watertight doors and valves is a peremptory order for every man not on duty to repair as quickly as possible to his station. Men on watch (either when steaming or in port) will remain at their stations until relieved by the men stationed there for that evolution, meanwhile carrying out the duties which are required at that station, so far as possible. The idea is that the above duties

must be performed as soon as possible; and as men on watch cannot leave their stations until relieved, they should perform every possible duty before the arrival of their reliefs—then repair immediately to their individual stations as specified in the bill for collision-drill.

15. **Carpenter's-gang** provide tools and material, including shores and wedges for shoring up endangered bulkheads and decks. These should be actually provided for exercise, at times when especially ordered.

PROVISION-CALL.

16. (1) In view of the possibility of a ship sinking after a collision, and the consequent necessity for abandoning ship, the provision-call will be frequently sounded after the signal to close watertight doors and valves. This is an order for all men (stationed to provide provisions for "abandon-ship") whose presence is not further required at their stations for closing watertight doors, to provide the prescribed provisions. These provisions will be placed in the boat itself, if convenient; otherwise, abreast the position at which the boat equips.

(2) After providing their own provisions, men will proceed to make other necessary preparations for abandoning ship. The provision-call may, therefore, be considered as a preliminary signal for abandoning ship, and while many men may be occupied below in the attempt to save the ship, bracing up bulkheads, getting out collision-mats, etc., no man not otherwise specially engaged should cease his work in preparing his boat, until every precaution short of lowering the boat has been made.

ABANDON-SHIP.

17. On signal for abandon-ship, each man proceeds with the least possible delay to provide his assigned portion of the boat-equipment, and boats are lowered, equipped, manned, reported, and shoved off. For drill, men absolutely necessary in the engineer-department will remain below, but a list of the names of such men will be submitted by the senior engineer-officer to the executive-officer. When actually abandoning ship, the furnace-doors will be opened, fires hauled and bleeders opened before the fire-room force leave their stations.

18. (1) Property.—Every reasonable effort will be made to save the log-book, muster-roll, accounts of officers and crew, cypher-code, and other valuable papers. In case of fire or shipwreck, it will be the special duty of the pay-officer to secure and preserve the accounts of officers and men, all public money, and such other public papers and property, in the order of their value, as circumstances permit.

(2) If it is impossible to carry signal-books and other confidential papers, they should be burned, or otherwise destroyed, in the presence of an officer.

19. Equipment.—Every boat used for abandoning ship should have the following equipment:

(1) **The complete boat-equipment** which is required to be kept in boats at all times, including a boat-compass and tarpaulin.

(2) **Rations for three days**, or as much more as the boat will carry safely. One ration for this purpose is: 1 lb. bread, $\frac{3}{4}$ lb. meat, and $\frac{1}{2}$ gal. water. When actually abandoning ship, if time permits and if landing is probable, a small quantity of salt, pepper, coffee, and sugar may be provided for use on shore; but this will not be provided at ordinary drill.

(3) At least two rifles and a supply of ammunition.

(4) Mess-gear and iron kettle.

(5) If possible, *a sextant, Nautical Almanac, Bowditch's tables, chart, paper, and pencil.* At least one boat, preferably that of the senior officer, must be so equipped.

20. At least two officers should go in every boat, if practicable, and carry service-belt, revolver, ammunition, and binoculars, if supplied.

21. (1) Steamers.—In the case of steamers, all preparations must be made for hoisting out boilers before leaving the ship; but circumstances will determine whether or not they shall be hoisted out. If abandoning ship at sea, or in very rough weather, the boiler should be lifted out; but in smooth water, near land, the

engine could be used to great advantage. Similarly, if abandoning ship in great haste, time might not permit the boiler to be hoisted out. In all cases, therefore, circumstances must govern.

(2) Men will be stationed to provide wrenches, pinch-bars, etc., for removing boiler, and the necessary purchases to lift it out.

(3) Masts, spars, and sails will always be provided. If the boiler is removed, the sail will be bent and mast stepped. If the boiler is to remain in the boat, coal and water must be provided and the mast and sails will be carried, but the sails need not be bent. In this latter case, tools will be carried in the steamer so that in case of emergency the boiler and engine may be dismembered and thrown overboard.

22. Secure.—When SECURE is sounded, boat-crews will secure their boats, open watertight doors, return supplies and fall in abreast places assigned for equipping. The boat-officers will report when all is secure.

23. (1) Notes.—The boat-officer should see that all men stationed in his boat at this evolution are present, and that they understand their duties. If a man is unavoidably absent, he should be notified, after the drill, of his station and duties.

(2) Freeboard.—Boats (except dinghies) should have not less than 12 inches freeboard when fully manned and equipped. If, after equipping, any boat is found to have less than this amount of freeboard, a portion of the crew should be permanently transferred by the executive-officer to some other boat. Ten inches is a fair freeboard for the dinghy class.

(3) Junior boats, which will usually not be able to obtain sextants, Nautical Almanacs, etc., will keep near senior boats which are so equipped, after they abandon ship.

(4) The particular stations of each man in a boat at abandonment will be determined by the boat-officer, and the men will be carefully drilled to take their stations quickly, quietly, and without crowding or confusion. The position of each article of equipment must also be carefully specified, and men stationed to stow articles must be thoroughly instructed with regard to the stowage-plan, according to a sketch of the boat clearly defining the positions of water-breakers, boat-box, bread, meat, etc., otherwise there will always be confusion of the personnel and slovenly stowage of the equipment.

(5) Composition of crew.—It is important that the abandonment crew of each boat should comprise the detail of the landing force assigned to that boat, increased by such additional men as may be necessary.

FIRE-DRILL.

24. (1) Details of individual duties, and duties of divisions at this drill, are prescribed in the station-bill of each ship.

(2) The same general instructions relating to the performance, first of specially designated duties, and afterwards of general duties within the limits of the division, will be observed as were specified under collision-drill.

(3) Any person discovering fire aboard ship will endeavor to extinguish it and prevent the spread of flames, assisted by those who are within call. Use will be made of hand-grenades and of such water as is immediately available; and word will be sent at once to the officer-of-the-deck. He will cause such measures to be taken as will insure the safety of the ship; sound the alarm-gongs and ring the fire-bell, if deemed expedient, and immediately inform the commanding- and executive-officers of the situation.

25. When not at general-quarters, the alarm for fire will be given by ringing general-alarm gongs and sounding solenoid-whistles to call attention, followed by the rapid ringing of the ship's bell and the *fire call* sounded on the bugle. The location of the fire will then be indicated by one stroke of the bell for fire forward, and two strokes for fire aft; and the bugle may be further used to indicate the deck or particular locality to which hose is to be led, as prescribed in the fire-bill for each ship.

26. Fire at general-quarters, or in action, will be fought by the division-officer and men immediately at the scene of the fire. In the absence of the division-officer, the senior petty-officer present takes charge and proceeds to extinguish it, sending a messenger to inform the division-officer. As far as practicable, crews in reserve should be used, as the fire of engaged guns must not be interrupted. Efforts must be directed to prevent the spread of flames, to remove spare ammunition to a safe distance, to divert chains of ammunition-passers passing too close to fire, and to isolate endangered magazines, flooding them if necessary. The commanding-officer will, so far as practicable, be kept informed of the progress of the fire and of the measures taken to extinguish it.

27. The crews should be exercised at fire-drill at least once in each week, varying the time of the exercise so that it will not be anticipated, but represent a real emergency.

28. (1) In general, it may be said that fire on shipboard is fought by drowning it with water; by isolating it; and by preventing draughts, thus smothering it. The officer-of-the-deck, or the

officer in immediate command at the scene of the fire, will take all necessary steps to control the spread of flames, closing all air-ports, watertight doors, hatches, air-ducts, etc., which are not absolutely necessary to supply air to the men fighting the fire.

(2) If the fire is forward, the ship should, if practicable, be brought stern to the wind, and vice-versa.

29. General duties.—At fire-drill, the following general duties will be performed within the limits of each division:

(1) Couple on and lead out hose from fire-plugs as specified in station-bill, connecting sufficient hose lengths to lead to the fire. If necessary, owing to the remoteness of the fire, streams which cannot be utilized may be dispensed with, and the hose lengths thus made available may serve to increase the lengths of the other lines to reach the fire. Hose from the forward or after divisions will only be led to the after or forward ends of the ship when specially ordered.

(2) Close and batten down all hatches not required for use.

(3) Turn ventilators from the wind, and haul up wind-sails.

(4) Close all watertight doors and valves in air-ducts required for isolating the fire, and to reduce draught. Leave open such as are necessary for fighting the fire. On completion of their duties, men report to division-officers and fall in at specified places.

(5) Rig and man all hand-pumps.

(6) Stop all blowers.

(7) Remove inflammable oils and liquids in the limits of division to a safe distance from fire.

30. Division-officers will see that all general duties required within the limits of their divisions are performed, regardless of possible absentees who are specially stationed for such work. If at anchor, they will see that all preparations are made for weighing or slipping; and if at a dock, for running lines and warping out,—the carpenter and blacksmith standing by with the necessary tools.

31. Axemen, smotherers, handy-billy-, and hand-grenademen, equip and fall in as directed, subject to orders of the executive-officer.

32. Bucket-lines.—When specially ordered, the men of any division, or divisions, who have performed their individual duties, may be formed into bucket-lines.

33. (1) The engineer-division will, in addition to performing as many of the above duties as are applicable, keep apparatus for fighting fire ready for use.

(2) Hose in engineer-department will not always be led out, but only as often as may be required to keep the men familiar with their duties.

(3) Pumps will be put on fire-main, carefully tended, and pressure maintained as prescribed.

(4) Valves in air-ducts leading to fire will be closed; also, all watertight doors necessary to isolate the fire, when they are not required to be kept open for access to men working in endangered compartments.

(5) Engines will be worked to signal from deck.

34. **The ordnance-officer**, with the gunner's-gang, should be ready to flood any, or all, magazines and shell-rooms; but no magazine or shell-room will be flooded, except in an emergency, without orders from the commanding-officer, or the officer-of-the-deck. He will also be prepared to remove explosives not in magazines from the scene of the fire.

35. **The pay-officer** will make preliminary provision for saving public money and records, and be ready to open store-rooms and issue provisions.

36. **The surgeon's-division** will make preliminary provision for the removal of the sick. Inflammable liquids under his charge will also be removed to a place of safety, or, if necessary, thrown overboard.

37. **The chief master-at-arms** will see the prisoners, under guard, removed to a place of safety.

38. **At night**, each man who is berthed amidships, will take one turn of lashing around his hammock and hang it outboard with both clew-rings on one hook.

39. **Store-rooms**.—All persons having keys of store-rooms stand by to unlock and deliver contents as called for.

40. **When provision-call is sounded** after fire-drill, the same preparations and duties will be carried out as prescribed when it follows collision-drill.

FIRE AND RESCUE PARTY.

41. **Organization**.—In each ship there will be organized a *fire and rescue party*, and the station-bill will designate the boats to be used and specify their equipment. The boats so designated should be those which at sea and in port are, from positions of hoisting and other circumstances, most available for service, and may be gotten away with the least delay. They should, when practicable, be manned by their regular crews, with such additions as may be necessary, and be commanded by their own

officers. Boats will carry their regular equipment except masts, spars and sails, which should be passed out, if there is time.

42. Employment.—*The fire and rescue party* will be organized and equipped to assist a vessel on fire; to rescue people from her, or from any shipwrecked vessel; to prevent the spread of flames to shipping which may be endangered, and to render similar assistance to property endangered on shore. As the particular emergency cannot be foretold, the entire equipment specified below should be provided at the boats by men specially detailed, while the crew proper of each designated boat clears it away, lowers, and prepares it for service. That part of the equipment provided, which may be used to advantage in the special emergency, will then be passed into the boats.

43. (1) Equipment.—Provide for each boat: at least six buckets, some with lines which may be used as lanyards to draw water; two axes; one crowbar; two grapnels, fitted with chain and rope for towing endangered shipping clear of the fire, or for pulling down endangered houses; two heaving lines; six life-belts and two life-buoys of circular pattern.

(2) Handy-Billy.—One boat, preferably a cutter, will carry a handy-billy with suction-pipe, two lengths of hose and nozzle, and six extra men to work it.

(3) A carpenter's-mate and blacksmith will provide tools for unshackling and slipping cables; and the cold-chisels, mauls, and other tools which may be required to break into compartments and cut through bulkheads. They will report to the officer in charge of the party, and will accompany it if there is a possibility that their services may be utilized.

(4) At the discretion of the commanding-officer, fire-extinguishers and hand-grenades may be provided; or, for service ashore, explosives, to be used in blowing up buildings.

44. (1) The *fire and rescue party*, as specified in the *station-bill*, may be augmented by additional boats and men as occasion requires.

(2) A surgeon should be detailed for duty with the fire and rescue party. He will provide the necessary medical outfit, and will accompany the party whenever his services are required.

CLEAR SHIP FOR ACTION.

NOTE.—Precautions necessary on square-rigged ships have been omitted from these instructions. The directions for clearing a ship of this type may be found in the publication issued by the Bureau of Navigation, entitled "General Instructions, Clearing Ship for Action, 1896."

45. (1) This must be regarded, not as a *drill*, but as an *evolution*. In the beginning of her commission, the ship must be repeatedly cleared for action until the best disposition for each article of equipment is definitely determined, and the members of the crew are thoroughly familiar with their duties. When all features of the evolution have been satisfactorily worked out, one exercise in each quarter, thorough as to detail and with all arrangements for battle critically inspected, should be sufficient to keep the crew to the proper standard of efficiency.

(2) The object of the exercise is to prepare the ship in all respects for action. While detailed notes are herewith given for the information of all concerned, it would be impossible to foresee and provide for the various contingencies of actual service; and these instructions must be regarded as memoranda for general guidance. The final test must always be: "*Is the ship in all respects as ready for action as we would desire if the enemy were in sight;*" and any particulars in which the preparation of the ship for actual battle falls short of this test must be immediately rectified.

46. At the commencement of hostilities, ships will land at navy yards all loose and inflammable articles and furnishings, including the chests, spars, boats, etc., which can be spared. For exercise, articles which would otherwise be put on shore will be labelled "*Overboard*." Articles which are so essential to a ship that they cannot be left on shore, such as are required in daily use and would be valuable after an action, will not be labelled "*Overboard*," and must be so disposed as to provide against fire and splinters and insure an uninterrupted service of the battery. During hostilities, ships will at all times be cleared for action, so far as may be practicable.

47. The time element is second only in importance to thoroughness in preparing for battle; and, if all preparations have been made, the time required for the evolution is a measure of the smartness and efficiency of the crew. Crews will work first for thoroughness, and then to reduce the time; but haste to report his division ready should never, under any circumstances, cause an officer or man to neglect details and precautions which would be necessary if the ship were going immediately into action.

48. (1) **Under way, and at anchor.**—Modern vessels are supposed to fight under way, therefore these instructions apply primarily to that condition; if at anchor during drill, it must be assumed that the ship is under way and all dispositions must be made accordingly.

(2) **Should a ship fight at anchor,** it would be under very exceptional circumstances, which the commanding-officer would take into account in making other preparations, such as putting springs on the cables, sending out kedges, improvising torpedo-defense, organizing picket-boat service, laying out defense-mines, sending boats ashore or anchoring them at a safe distance from the ship, preparing for slipping and weighing anchor, etc.

49. In clearing the ship for action, the commanding-officer will decide whether or not to postpone certain items of preparation until action shall appear imminent, such as closing air-port bucklers, sending binnacles below, etc.; but a ship will not be considered cleared for action until all the prescribed details have been carried out.

50. **Preparations for battle.**—In clearing ship for action, the principal points to be considered and provided for are:

(1) *Prepare the battery*, battery-accessories and supplies for immediate use, the procedure following as closely as practicable the drill-regulations. Test all electric firing-circuits. Mount boat-guns on ship's mounts, if such are provided. Get up spare parts of guns and mounts and dispose them so as not to menace the personnel, yet near at hand, behind armor, or in drum-rooms or other unoccupied spaces, near guns.

(2) For every division of main-battery guns not in turrets, provide two tackles with which any gun of the division may be trained in case its training-gear is disabled.

(3) Send top-guns aloft, if not already there.

(4) Ship cranes, and hook tackles and jackstays for hoisting ammunition to deck and to tops.

(5) Prepare and test all ammunition-hoists.

(6) *Apply power*, and test all hand, steam, hydraulic, pneumatic or electric gear, employed in the working of turrets, heavy guns, and ammunition-hoists.

(7) *Load the ammunition-car for each turret-gun* and have shell and charge on the carriage in handling-room; make preparations for supplying ammunition as rapidly as it may be required; provide magazine-candles for use in case battle-circuit fails.

(8) Provide on deck two shells and charges for each gun (except turret-guns) of the main-battery.

(9) Provide one box of ammunition for each rapid-fire or machine-gun of the secondary-battery, either on deck or aloft. Provide ammunition for filling small-arm cartridge-belts; fill them in actual service; have small-arms in armories ready for issue.

(10) *Fill gun-tubs and buckets*, magazine-buckets and water-cans, and buckets in tops, with fresh water. Gun-tubs are supplied by the Bureau of Ordnance, one for each B. L. R., for use with fresh water and marine-sponge. Drinking-water for magazines and handling-rooms is placed in water-cans if provided, or, in the copper-bound buckets supplied for magazines [Part II, Art. 31, (7)]. The latter will, in case water-cans are provided for drinking-water, be filled with salt water for use as fire-buckets. At predetermined points, where bucket-lines could be operated to advantage in case the fire-main were shot away, place fire-buckets, some with lanyards, in groups of two or three.

(11) *Haul galley fires* and extinguish all lights and fires which will not be necessary during battle. When clearing for exercise only, the galley fires need not be hauled.

(12) *Prepare range-finders* for use; test all systems of interior communications required in action.

(13) Ship torpedo- and ammunition-trolley tracks, or (if deck-trucks are used for transporting) place truckways at bulkhead doors; provide handling- and transporting-gear, transport torpedo to tube from which it is to be fired. In war, place torpedoes in tubes with war-heads on ready for use, and adjust them to sink at end of run. If for exercise, fill and attach exercise-head and adjust to float at the end of the run. Ship torpedo-directors, start air-compressors and charge accumulators and torpedo air-flasks. Adjust torpedo-mechanism and gyro steering-device.

(14) Provide heavy spare parts, as directed in Part II, Art. 110, and place them convenient to the guns, but in such a position as not to endanger the personnel.

51. Clear decks, for the passage of ammunition and for the free movements of the crew, are essential to the efficiency of the ship in action. Articles about the decks not marked "*Overboard*" must be so stowed that there will be the least interference with the operations incident to action, and at the same time where they will cause the least danger from fire and splinters.

52. (1) Combustible materials.—Because of the seriousness of

fire in action, especially on covered-battery decks, combustible materials there should be sent to the holds, berth-, splinter- and platform-decks, and stowed so as not to endanger the personnel, and where they will least interfere with the ammunition-supply. If such material is retained on battery-decks, it must be removed as far as practicable from the guns and disposed behind casemate armor, in drum-rooms, wash-rooms, water-closets, prisons, closed gun-supports, or in other closed compartments in which men are not stationed in action.

(2) Prepare to throw overboard turpentine and alcohol tanks, carboys of acid, varnish, driers, kerosene oil, etc. (To be labelled "*Overboard*" for exercise.)

53. (1) **Skid-beams.**—Fit securely a stout netting across the deck under, and secured to, the skid-beams.

(2) Skid-beams are often directly over secondary-battery guns, and it has been found that even when nets are stretched beneath them, the protection from splinters is inadequate. They should, therefore, never be used for stowage unless covered by a splinter-deck.

54. (1) **Arcs of fire.**—Secure the maximum unobstructed arcs of fire for all guns of the battery.

(2) Come up and carry inboard (to fighting position if so fitted), rigging that interferes with the fire of any gun, hooking and setting up pendant-tackles, if necessary, to support masts.

(3) Unstock all anchors whose stocks interfere with the gunfire. Lower fish- or anchor-davits. Fold down all boat-davits, so fitted. Lower all poop-, forecastle- and bridge-railings, fitted to hinge down, and unship all not so fitted. Remove any portable object which may obstruct the fire of any gun.

55. (1) **Fouling the screws.**—Take precautions against fouling the screws by wreckage, etc. Unreeve and send down all unnecessary gear. Swifter in rigging.

(2) Provide for use on each quarter a strong grapnel with a line not less than three inches in size, with a suitable whip or tackle, snatch-blocks and rope-straps by which they may be secured to bolts, or cleats, and a fair lead obtained at any point on the rail, to catch and trice up gear that threatens to foul the screws. Place a grapnel and its gear at some safe position, convenient to each quarter.

56. **Compasses.**—Send below standard compass; leave in place all other compasses; place a compass in steering-engine room, if not already installed.

57. Steering-gear.—Prepare spare tiller and relieving-tackles as far as possible, without interfering with the full efficiency of the steering arrangements. Connect up and test all the various means provided for steering the ship in case the steering-gear in the conning-tower is shot away or disabled; then disconnect such as interfere with the steering from the conning-tower.

58. (1) Falling spars and rigging.—Reduce as much as possible danger from splinters, fire, and falling spars. If possible, guy masts, so that if shot away they will fall in the directions that will do the least damage.

(2) Put preventer-lashings on Ardois-cable, and wireless-telegraph receiver, to prevent, if possible, their falling on deck if the topmasts are shot away.

(3) Put preventer-lifts on signal-yards.

(4) Drop the peaks of all gaffs, and lash gaffs, booms, flag-staffs, etc., up and down the masts. Rig in and lash lower-booms and quarter-booms on outside of ship.

(5) Stow all solid rails below in compartments which will not be used in action. If wire-rope railings cannot conveniently be stowed in splinter-proof store-rooms, on or below protective-deck, trice them up alongside the lower-masts, and lash them with the lower rigging.

59. Over the side.—As far as practicable, sling and lash securely over the side light masts and yards (unless disposed up and down the lower-masts), spare spars, coaling-booms, awning-stanchions, unoccupied davits, unshipped ladders, gangway, sentry and other heavy gratings, etc., being careful not to obstruct the arcs of train of any gun or torpedo.

60. Boats.—See all davit-boats well gripped and secured. Place sails or awnings around all boats to check the flight of splinters, and wet them down, guarding especially the inboard sides. This applies only to such boats as would be carried in war; the others are to be labelled "*Overboard*," and the disposition of the davits is to be indicated by labels.

61. (1) Gratings.—Have gratings and tarpaulins at hand in readiness to cover hatches.

(2) Close metal gratings in engine- and fire-room hatches, if open. See all armor-gratings in place.

62. Ladders and skylights.—Leave in place all ladders necessary for free movement about the ship. Unship the others, and if not hung over the side, stow them so as to avoid as much as possible their doing damage if struck by shot. Unship skylights

of hatches used for ammunition-supply and place them as remote as possible from the guns. Leave the other skylights in place, if they do not endanger the crew, raising them or opening them to diminish the damage by concussion.

63. Miscellaneous.—Dismount and stow away field-carriages. Secure division supply-chests where least likely to do damage if hit. Remove blocks, racks, torpedo-cages, diving-apparatus, kedge-anchors, removable ventilators, wash-deck gear, buckets, belaying-pins, work-benches, grindstones, tools, tool-chests, spare oars, lumber, capstan-bars, mess-tables and benches, ditty-boxes, and generally all articles and fittings that interfere with the working of the battery, torpedoes, or ammunition, or that will not be needed during the action, and stow them as indicated in general instructions.

64. Splinter-screens.—Dispose awnings, spare sails, etc., thoroughly wetted, as shelters, or splinter-screens. Place canvas over wooden bulkheads below to protect the ammunition-supply. (When for exercise only, the canvas need not be wetted.)

65. Hose.—Attach hose to all hose-connections and keep snugly reeled or bighted up with nozzles on and couplings tight. At the end of this evolution (clearing ship), if action is imminent, start the steam fire-pumps, if fitted with relief overflow-valves, and keep them running during the action. (To be always done at exercise.)

66. (1) Under-water injuries.—Be ready to repair injuries below and near the water-line; have armorer's and carpenter's tools and breeches ready; in case of injury, confine it, if practicable, to one compartment.

(2) *Close all gates and sluice-valves*, and all watertight doors and hatches; then reopen such as may be designated as needed for the service of the fire-rooms, engine-rooms, and ammunition-supply. If different compartments are freed through a common drainage-main, open pumping-valve connected with the largest compartment and close the others. Put one fire- and bilge-pump on fire-main and the others on the drain.

(3) Prepare *collision-mat* for use.

(4) Distribute *leak-stoppers* below where they can easily be reached, and open boxes and prepare them for immediate use. Most steel ships are now fitted with patent leak-stoppers, which stop the hole by the stopper swelling when it gets wet. This is the only stopper that will close a jagged hole. The use of leak-stoppers and the mat should keep much water out of the ship. By

having watertight doors closed and men at the pumps and drains, water which enters may be pumped overboard.

67. Warning and escape.—Insure an efficient means of warning and escape to those below. This is done by seeing that all mechanical and electrical alarm-gongs and solenoid-whistles are in working order, and that men in each compartment know what they mean, and the route by which they leave compartments and reach the deck.

68. Anchors and chains.—Put preventer-lashings on anchors. If on the open sea, unbend cables and send them below, if not disposed in any part of the ship as additional armor-protection. If in the vicinity of land or in shoal water, keep one cable bent.

69. Voice-tubes and telephones.—If any voice-tubes or telephones are divided into branches, connect those that lead to the most important battle-stations and close the others.

70. Air-ports and bucklers.—Close all ports below the spar deck. At night, close air-port battle-bucklers.

71. (1) Wreck clearing.—Provide and distribute around the ship-grapnels, axes, pinch-bars, hatches, saws, etc., for use in clearing away wreck. One set of these should be available for the use of every division.

72. Repair-stations.—Establish repair-stations about the ship, where electricians, carpenters, blacksmiths, armorers, gunners, etc., equipped with tools and material necessary to make repairs, may be at once available if required.

73. (1) Electric-circuits and search-lights.—Connect electric battle-circuits. For night action start all dynamos needed for search-lights (in addition to those needed for interior illumination), and keep them running at standard speed, if practicable. Remove unnecessary electric lamps, lamp-globes, and shades. Darken ship so no lights show from outside, but retain sufficient light on board to enable an efficient service of the guns; experience has demonstrated that considerable light about the guns is necessary for their efficient services. For day action, secure search-lights from shock of discharge of guns, or remove them if they interfere with the fire of the battery, and carry the glass doors to safe places. At night, have search-lights ready for use.

(2) Trim, light, and distribute oil-lamps where they will be most needed should the battle-circuits fail, then extinguish them. Matches must be at hand and men stationed to relight lamps, if necessary.

- 74.** (1) **Engineer-department.**—Start ventilating-blowers and see louvres open where needed, and closed where not needed.
 (2) Set up smoke-pipe guys.
 (3) Hoist out all ashes.
 (4) Light fires under all boilers. (For exercise only, prime all furnaces.)
 (5) Fill feeding-bunkers and spread as much coal on fire-room floors as can be conveniently placed there. As far as practicable, fill all lower bunkers, but retain coal in such bunkers as are necessary for protection, unless its use is probable and too much time will be required to strike it below in action.

(6) Close stop-valves of steam-pipes leading to all machinery above protective deck which will not be used in action. Have levers ready for working boiler stop- or safety-valves from berth-deck or passages.

(7) Starts fire-pumps as directed in Art. 65.

75. Surgeon.—The surgeon will prepare for battle in accordance with instructions under "Medical Department in Battle" (Arts. 95 to 103). He will inspect the relief- and dressing-stations; see that the men detailed therefor are present; that they understand the duties required of them; that they are ready for duty, and that these stations are properly equipped. He will see that satisfactory means for transporting the wounded and for lowering them to the dressing-stations, are provided, and, in brief, that all arrangements that would be necessary in action for the care of the wounded, are made at this exercise.

76. Paymaster.—Place the public funds and important papers in such shape that they may be carried away or destroyed, as directed.

(1) **Navigator.**—Sends below the protective-deck the chronometers, other important navigating instruments not required in action, and the sounding-machine, if not on soundings.

(2) If on soundings, have the sounding-machine and hand-lead and lead-lines ready for use.

(3) Test signal-apparatus, arrange signal-flags, and have the charts and navigating implements required ready for use.

(4) See that signal-books are in weighted covers, ready to be thrown overboard, if so ordered.

78. Prisoners.—For actual battle, release prisoners.

79. Ensigns.—Hoist battle-ensigns at mast-heads.

80. (1) General dispositions not covered above would be made in accordance with existing circumstances.

(2) All such general dispositions cannot be explicitly enumerated, as they depend upon the ship, and vary with the conditions of service; but at every exercise in clearing ship for action, it must be borne in mind that whether covered by instructions or not, every article which would interfere in action must be removed, and all that would be of use must be provided. On completion of the evolution, the ship is supposed to be ready in every respect for battle.

GENERAL-QUARTERS.

81. The object of specially describing this exercise is to indicate practical and beneficial lines along which it should be conducted, and to discourage certain antiquated exercises which consume time without increasing the value of the ship as a fighting unit.

82. At each exercise at general-quarters, every preparation and disposition, except clearing ship, which would be made in action, will be carried out. The ship will, for the time being, be supposed in action, and the drill will be made to simulate an action as nearly as possible; therefore, such articles as arms, water, etc., as are required to be supplied at *Clear ship for action* will be supplied whenever the ship goes to general-quarters, without clearing ship. Similarly, dispositions made at *Clear ship*, which come into the *drill* of the gun-crews, such as leading out hose, will be made at general-quarters. These duties, which are to be made at either evolution, are enumerated under *Clear ship for action* [Arts. 50, (1) to (13); 57; 65; 67; 69; 71; 72; 73; 74, (6); 75]. Officers and men will have the exact stations they would occupy, and they will perform the same duties and use the same systems of communication, fire-control, range-finding, etc., that would be employed in action.

83. If exercising at general-quarters and the ship has not been cleared for action, all fire-hose should be connected to fire-plugs, ready for use. In war, although the ship would be in a generally cleared condition, it might be inconvenient to keep the fire-hose connected at all times; but it should be connected at night, and during daylight when action seems probable. Hose will, during action, be preferably handled by unengaged crews; and during drill and when general-quarters are sounded, by crews designated as unengaged by the executive-officer.

84. Each exercise at general-quarters should be a distinct problem, with the conditions of which the officers have been made acquainted. On different occasions, the ship may be supposed at anchor or under way, repulsing a torpedo-boat attack, fighting another similar, or distinctly different type of ship, engaged in a fleet action, or repulsing several vessels attacking her simultaneously; and the various phases of the exercise should follow and be governed by the phases of such theoretical engagement.

85. The employment of certain guns, the sending of other crews in reserve, the employment of riflemen, the reinforcing of crews, should be carefully arranged for, according to the varying condi-

tions of the supposed action. In other words, the exercise should be used to develop the efficiency of the ship as a fighting unit, and so to train the crew that, so far as information on the subject is available, an action would simply be a repetition of this drill, with the exception of the actual firing of the guns. The drill should assume that catastrophes have occurred, the remainder of the drill being carried out with the means supposed to remain, as would be done in action. It might profitably include even such variations as sending a prize-crew on board the enemy, saving his drowning, abandoning the ship, a serious conflagration requiring the cessation of fire from otherwise serviceable guns, or fire with fire-main destroyed in that part of the ship. In this drill, the training of individual gun-crews should not be attempted, except to represent casualties either to personnel or materiel, as the individual crews are supposed to be expert before they go into action, and should be made so by individual battery-drill before very seriously taking up the question of general-quarters.

86. Unless it is impracticable for urgent reasons, every man on board ship must be at his regular station for general-quarters. Individual gun-crews will carry out the regular drill at their guns, using dummy ammunition, and every movement will be carefully executed under supervision of the gun-captains, who will also see that every order in regard to sight-setting is promptly and scrupulously obeyed by the sight-setter.

87. Individual crews may, at any time during the exercise, be exercised at "casualties," by the division-officer commanding "*Gun No. —, miss-fire*"; *hang-fire*; *jammed cartridge-case*; *burr*, etc.; or, in the case of a turret: *training-gear gone*; *ammunition-hoist gone*; *rammer gone*; etc.

88. The battle-indicator must be carefully watched and its indications promptly obeyed by each crew, never firing unless the object and range are known. If there is a correction to the range-transmitter, the sight-setter should know it and always use it.

89. At general-quarters, the details of the use of torpedoes, when provided, should receive the same consideration given to the guns of the battery. They should be used at the proper theoretical phase of the action—the preparation, pointing, and firing of the torpedo, the means of communication, etc., being in all respects the same as they would be in action.

90. General-quarters held at night will be along similar praec-

tical lines. At certain times the problem should be a torpedo-boat attack, using boats manned by the turret- or main-battery crews, if practicable; at others, it should be a theoretical fleet-action, or, an engagement with a similar, or very different ship. When the exercise represents a torpedo-attack, men should be stationed some time before the attack, as would be done in action, assigning arcs of fire to different guns, stationing riflemen and lookouts, closing all possible watertight doors and valves, placing air-port bucklers, and screening all lights which would show from outside. Upon discovery of the boat, the general-alarm will be sounded; but collision-signal only if directed by the commanding-officer.

91. In all of these exercises, the guiding principle should be to drill the crew as nearly under service conditions as is possible, so that in the event of action the usual drill would simply be repeated. Time and trouble should not be allowed to prevent this, and no general-quarters exercise should begin without first deciding upon some particular problem which the drill is to represent.

92. When at sea, a mutually beneficial exercise would be for two ships, or two divisions of a fleet, to hold general-quarters while maneuvering as if in action with each other. No better exercise for the control of gun-fire and of the system of range-finding and interior communication could be devised.

93. While in the development of various problems it is undesirable to limit commanding-officers in any particular, attention may be invited to the superior importance of the development of battery-control, range-finding, establishing and exercising interior communication by various methods, etc., to obsolete customs of charging forward, rallying at designated places, calling away boarders, firemen, wreck-clearers, etc.

94. (1) Experience has conclusively demonstrated the inadvisability of withdrawing any of the crew from a gun which is firing; therefore, when riflemen are required, whole crews from designated guns should be called. Wreck-clearing and fighting fire in action must be done by the officers and men on the spot, the officers using such men or crews as may be necessary—preferably unengaged crews.

(2) Boarding in action will seldom be required, and though rifles and revolvers are provided for gun-crews in designated places, such as armories, drum-rooms, etc., as a preparation for the remote contingency of a boarding-attack, time should not be

wasted in this maneuver until expertness in other details has been attained.

The Medical Department in Battle.

Prepared by Surgeon C. F. Stokes, U. S. Navy.

95. (1) Organization.—A definite plan for the organization of the medical department in battle cannot be laid down for each ship, as those of different classes, and even some ships of the same general class, vary materially in the arrangement of their batteries and the protection afforded officers and men, as well as in many other details.

(2) The organization for the medical department, showing all dispositions to be made under battle-conditions, should, however, be worked out for each ship, as soon after going into commission as practicable, and should provide for relief-stations and surgeons' dressing-stations as described below.

96. Duties of the hospital-corps.—As the most important duties of the medical officers and members of the hospital-corps are performed when the action is over, they should avoid exposing themselves unnecessarily, as they cannot be replaced on board ship. In a recent naval battle the surgeons and men of the hospital-corps and many of the wounded, while in an exposed position on one of the engaged ships, were killed by the explosion of a shell, which also destroyed the bulk of the surgical dressings and other equipment. The ship was left for nearly twenty-four hours with scores of wounded in a pitiful condition. This shows the great importance of the instruction of all men in the precautions to be observed in the handling and care of the wounded—see “Notes on First Aid” in “The Landing Force and Small-Arm Instructions, 1905.”

97. (1) Relief-stations.—Relief-stations should be established at various protected points about the ship, in the neighborhood of, and accessible to, the men who are most exposed.

(2) These stations should be manned by men who have been carefully trained in applying first-aid in the case of shell-wounds, etc. These men should report to the senior medical officer and should, if possible, be specially detailed for these stations, and have no other duties to perform in action; but in case the complement will not permit this, they should be drawn from the stations from which they can best be spared. In no case, however, where it is possible to avoid it, should they be members of main- or intermediate-battery gun-crews, either on engaged or unengaged

sides. At least four men should be assigned to each relief-station.

(3) During a battle, the members of the relief-station crews will constantly visit the various accessible portions of the ship in their vicinity, where wounded men are likely to be found, and will remove the wounded to the relief-stations. They will, if possible, administer "first-aid" before transporting the wounded man to the relief-station.

(4) The wounded men are laid to one side by members of the gun-crew. It is desirable, if possible, to remove them entirely clear of the gun-crew, not only for their own protection, but also to avoid the demoralizing effect that the presence of the wounded often has on others.

(5) In turrets, and at other inaccessible points, first-aid will be given by the members of the gun-crew who have laid the wounded to one side. It will probably be impracticable to remove such men to the relief- or dressing-stations until after the engagement; and it will also probably be impracticable for the members of the relief-station crews to visit such men during the action.

(6) In order to save the wounded men from grave wound-poisoning, their wounds should be dressed as promptly as possible. It is to this end that the relief-stations are established, since it will probably be impracticable, except in the most serious cases, to carry the wounded below to the surgeon's dressing-station during an action. In case, however, a life may be saved by an immediate operation, the members of the relief-station crews will transport the man to the surgeon's dressing-station without delay.

(7) A hospital-corps man or, in case there are more than two medical officers, a junior medical officer, should visit the different relief-stations from time to time during the action to see that they are satisfactorily equipped, and that the wounded are being properly cared for.

(8) As soon as the action is over, the wounded should be removed from the relief-stations to the surgeon's dressing-stations or to the operating-room, by men detailed for that purpose. The medical officers and hospital-corps men should, if possible, see that the men are properly prepared for transport.

98. (1) The dressing-station.—The surgeon's dressing-station should be easy of access from all parts of the ship; should have an abundant supply of water close at hand; should be behind armor, or other protection, if possible; and should be well lighted, well ventilated, and as cool as the circumstances will permit. As

a rule, the dressing-stations in a battleship should be located behind the armor-belt. It may be advisable to establish two dressing-stations, so that the surgeons can go from one to the other, work being prepared at one while the other is in use.

(2) The station of the senior surgeon during action will, as a rule, be at one of the dressing-stations, where he will provide the necessary equipment for important surgical operations and dressings.

99. Operating-room.—The ship's operating-room, which will usually adjoin the sick-bay, may be made use of after the action to supplement the dressing-stations. This operating-room, on ships so provided, will not be used at general-quarters; but the relief-stations and one or more dressing-stations will always be equipped at this drill.

100. Properly-fitted cots or stretchers will, when necessary, be prepared by the Medical Department for lowering the wounded, by means of whips or tackles (rigged by the deck-force or by members of the deck-force temporarily assigned to the Medical Department), to the dressing-stations below; but such appliances, being slow and cumbersome and constantly liable to disablement, will be used only in case the ship is not supplied with more efficient devices, so designed as to facilitate transporting wounded men by hand, directly from the relief-stations to the most convenient hatch, down which they will be lowered or passed by hand to the decks below, thus accomplishing this important duty with greater certainty and rapidity.

101. General-quarters, being but an exercise simulating action, in so far as it is possible to do so, the surgeon will seize this opportunity to instruct the crews of the dressing-stations, and particularly the relief-stations, in their duties in action, and to *drill* them in the prompt and proper performance thereof, assuring himself that all members of the relief-crew are competent efficiently to administer first-aid; that they understand their station and the limits of the ship assigned to them, and that they are efficient in the performance of the duties which will be required of them. In general, he will avail himself of this exercise to *drill* and *perfect* the personnel of the Medical Department, and those temporarily assigned thereto, in all duties necessary in battle.

102. The galley.—Immediately after an engagement, the galley and bakery should be placed at the disposition of the medical officers. They will require hot water in abundance, and dressings and instruments will have to be baked and boiled repeatedly to prevent wound-poisoning.

103. The hospital-ship.—When there is a hospital-ship close at hand, the wounded should be transferred to her as promptly as is consistent with their welfare. A fighting ship should be cleared of wounded as soon as possible after an action, in order that she may be made ready again to engage in battle.

PART IV

SMOKELESS POWDER, GUN-COTTON AND TORPEDOES

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U. S. NAVY SMOKELESS POWDER.

1. (1) Navy Department Special Order No. 39, dated April 13, 1903, contains instructions prepared by the Bureau of Ordnance with reference to the care, preservation and inspection of smokeless powder stored in magazines on shipboard.

(2) These instructions are too comprehensive to be incorporated herein, but they demand the careful study of all concerned, and nothing in the following notes relieves, in any degree, any person from strict compliance therewith.

2. Smokeless powder is now the only kind used as a propellant in the U. S. Navy, the brown-prismatic powder having been withdrawn from service, and black powder being used for ignition- and saluting-charges only.

3. (1) **Manufacture.**—Smokeless powders are made by four private powder factories and by the Naval Powder Factory at Indian Head, and until recently was made at the Naval Torpedo Station. The manufacture is practically divided into five stages, assuming that the cellulose, or raw material, is first thoroughly cleaned. The stages are:

- (a) The nitration, or manufacture of pyro-cellulose.
- (b) Its purification and dehydration.
- (c) Its colloiding.
- (d) Its pressing into various forms and sizes of grains.
- (e) Its drying, blending, and packing.

(2) *The nitration* consists in converting the plain cellulose into nitro-cellulose by immersion in a mixture of nitric and sulphuric acid, the sulphuric acid playing the part of absorbing the water formed by the chemical reaction.

(3) *The purification* consists in washing, boiling, and thoroughly pulping this nitrated material. For this purpose, cold washings, boiling and pulping are given it, the pulping being for finely subdividing the fibers in order to render every part of free acid in the fiber accessible to the boiling and washings. This purified pyro-cellulose is thus a "low nitration gun-cotton," which, after dehydration, is soluble in ether-alcohol.

(4) *The colloiding* consists in dissolving the purified, dehydrated nitrocellulose in ether-alcohol, making it into a thick, viscous colloid of considerable ductility and tenacity.

(5) *Granulation*.—This colloid is then pressed, by heavy presses, through dies into the shape and size of grain desired, the dimensions of which regulate the adaptability of the powder for various calibers of guns.

(6) *Drying, blending, and packing*.—After granulation, powder is put through a drying process, during which all but a small percentage of the volatiles left from the colloiding process are expelled and the grains shrink down to the dimensions suitable for the caliber for which they were designed. After drying, the powder is sent to the packing house to be blended and packed.

4. (1) **The percentage of volatiles** left in the powder varies from about 3 per cent in the 1-pdr. to 6.8 per cent in the 12-inch, 40-caliber. Of the volatiles left, much the larger amount is alcohol.

(2) In order to obtain uniformity in the matter of volatiles, which include, also, surface-moisture collected in exposure during packing, the packing is directed to be done in dry weather, and to be exposed about the same length of time while packing, the firing-sample being selected from the middle time of this packing.

(3) The powder is packed in air-tight boxes or tanks.

5. (1) **Lots and indices**.—In the process of manufacture, the pyro-cellulose must necessarily be divided into lots of such size that all parts of them will have been as nearly as possible through the same process.

(2) Such a lot (of pyro-cellulose) is the maximum quantity which can be put through every one of the purification processes as a whole, and it is given a lot-number which is carried through all the stages of manufacture, up to the point of blending. These lots, when they arrive at the packing house, are blended into a larger lot (known as a "lot of powder") which is tested chemically and ballistically and is assigned a service index-number by the Bureau of Ordnance, after which it ceases to be known as a lot, being from that time identified by its index-number.

(3) A "lot" of pyro-cellulose should not be confused with a "lot" of smokeless powder. The former is the quantity of pyro-cellulose contained in a poacher at the end of the purification process. A "lot" of powder may be made up of several "lots" of pyro-cellulose, and, if so, is carefully blended after drying, and becomes a certain index, after passing the required tests. Each index represents, as nearly as may be, about 50,000 pounds. For the same gun, the weight of charge of different indices varies greatly.

6. (1) **Color.**—Owing to various causes, such as mineral salts in the water used in the manufacture, raw material containing the cellulose, and other causes, the powders made by the various manufacturers have distinctive and different appearances, some being dark and opaque, others translucent; and it would be well for officers to familiarize themselves with the appearance of the various kinds of good powders, so as not to be misled by the appearance into mistaking a good powder for one that is deteriorating.

(2) The process of "water-drying," that is, separating the excess of solvent under warm water, renders powders whitish and opaque—a sickly color apt to give, to those who have never seen this kind, the impression of decomposition in an advanced stage. (Water-dried powders are marked S. P. W. instead of S. P., for example, S. P. W. 231 instead of S. P. 231, etc.)

(3) A number of earlier powders contained oxygen-giving salts, such as potassium- and barium-nitrate. These powders have a reddish, murky, opaque appearance which is sometimes alarming. Barium-nitrate powders are found among the first fifteen indices only, and they may be distinguished by the roughness of the grain and fine white specks of the metallic nitrate.

7. (1) **Proof of powders.**—Samples from each index of smokeless powder are sent to the Naval Proving Ground, where they are analyzed and subjected to the heat-tests, and fired in a gun under a temperature simulating that of a hot magazine on ship-board, namely, between 90° and 95° F.

(2) The powder is warmed in air-tight tanks to a temperature of 90° to 95° F., and a series of shots fired from the gun for which the powder is intended, using shell of standard weight, and taking velocity and pressure for each shot. It is customary to begin with low velocities and pressures, and by gradually increasing the charge, work up to the proof-pressure of the gun (20 tons per square-inch in the new high-powered guns, 17 tons in the older guns). Pressure- and velocity-curves are plotted as the shots are fired, and after the curve is completed up to the proof-pressure of the gun, one or two check-shots are fired, picking off the charge that should give the required working-pressure and velocity.

(3) The ballistic results, and their corresponding weights of charge, together with the accurate measurements of the dimensions of the grain, the residual volatiles and the general character of the laboratory tests of the powder, determine its suitability for the gun.

(4) A "test-sheet," as it is called, containing all these data, is made out and forwarded to the Bureau of Ordnance, which then assigns the weight of charge and index-number of the powder, and directs its shipment to designated magazines to be made up and distributed to the service.

(5) Powders when proved are fired at pressures above the working-pressure, to insure the non-existence, within reasonable limits, of a critical point—or "jumping-off point"—in the pressure-curve. If a tendency in this direction is developed the powder is rejected.

8. (1) **Loss of volatiles after issue** has an important bearing upon the action of the powder. The powder-charges fixed by the Bureau of Ordnance are based on a standard condition of dryness of the powder, and this standard condition should be maintained as nearly as possible.

(2) Powder freely exposed to the air at the temperature of a ship's magazine would gradually dry out or lose its solvent, and become more and more violent and give higher pressures and velocities, owing to its increased rate of burning. By confining the powder in sealed tanks, the escape of the volatiles should be almost wholly prevented, but that this is not absolutely so is known by the odor of ether that is always present in a smokeless-powder magazine.

(3) Tanks and sealed cases sometimes cease to be air-tight because of rough handling in shipment or on shipboard; powder should be removed from such tanks or cases and placed in tanks which are air-tight. Powders are now issued in a drier condition than they were formerly, and are better packed; however, experience shows that they will always dry out slightly after issue.

(4) Experience has shown that the curve, whose coordinates are *time since manufacture*, and *percentage of volatiles* in the powder, resembles very strongly, if it is not exactly, a hyperbola approaching an asymptote, and this seems to be borne out in practice—no powder, however old, having been found entirely devoid of volatiles. The point for issue of powders to service is now selected such that the point of dryness of the powder is at a point of the curve where a further increase is a minimum.

(5) It has been demonstrated at the Proving Ground that the loss in volatiles, as determined by chemical analysis, is almost exactly shown by loss in weight, where the weight is *accurately* determined. From this it would seem probable that we may in future obtain, after more data have been secured, the relation

between increase of velocity and loss of volatiles, of which a fair estimate could be made on shipboard, always provided that the charge was accurately weighed when issued.

9. (1) Effects of surface-moisture.—Smokeless powder, in common with most other non-metallic substances, takes up moisture on its surface, the amount varying according to the weather conditions. Under ordinary conditions this amount is about 0.5 per cent. Its effect on the ballistic results is about the same as that of an equal amount of solvent, i. e., its presence retards the rate of inflammation and combustion. For this reason, as well as for others previously mentioned, it is important to keep all cases and tanks hermetically sealed until just before the powder is to be fired, and it is particularly important that powder-charges be not exposed to moisture or to a moist atmosphere.

(2) The following results were obtained in firing a 5-inch, 50-caliber B. L. R., with the same weight of charge and projectile in each case.

	I. V.	Tons.
Powder at 93° F.	2859	14.8
“	2863	14.75
Powder at 60° F.	2793	13.75
“	2802	13.80
Powder dipped in water at 60° F. but no free water in charge.....	{ 2643 2612	{ 11.95 11.57

10. (1) Effects of temperature of charge.—For a given weight of powder-charge, the initial velocity for any gun increases slightly with the temperature of the powder at the instant of firing; for a given increase of temperature, the increase in velocity varies with the initial velocity. Our powders are tested and charges fixed to give prescribed velocities when fired at the standard temperature of 90° F.

(2) According to the data available at present, the following table gives the corrections for temperature of charge; and while it is not entirely exact, it is sufficiently so for all practical purposes. The table is compiled from a similar table issued by the War Department, the difference being that the temperature of proof is herein 90° F. instead of 70°, as used in the War Department tables. It is deduced from the following formula: $\Delta V = KV(70 + T)^{3.890}$, in which K is a constant whose log equals .15650-10, and T is the temperature in degrees Fahrenheit.

Substituting different values for T , gives values of ΔV corre-

sponding thereto. 90° , being the temperature of test, is entered 0 in the table; the numbers abreast other temperatures are the differences between the values of ΔV_{90} and ΔV_T . The results thus obtained agree very closely with those obtained by experiment between 60° and 100° F.

(3) Table Showing Corrections to Initial Velocity for Temperatures Above and Below 90° F.

Temperature of powder at moment of firing.	INITIAL VELOCITIES.							Remarks.
	1325	1700	2100	2300	2400	2500	2800	
- 10°	73	93.9	115.9	126.8	132.5	143.5	153.0	
0°	71.9	92.2	114.0	124.7	130.4	141.0	150.1	
10°	69.8	89.5	110.5	120.9	126.5	136.9	145.6	
20°	66.8	85.8	105.9	115.9	121.2	131.2	139.5	
30°	63.1	81.0	100.0	109.6	114.5	124.3	131.0	
40°	57.3	73.6	90.8	99.5	103.9	112.7	119.6	
50°	50.3	64.6	79.7	87.3	91.4	98.9	105.9	
60°	41.4	53.1	65.5	71.7	75.1	81.4	87.0	
70°	30.4	39.0	48.0	52.6	55.0	59.6	63.8	
80°	16.2	20.8	25.8	28.2	29.7	32.0	34.7	
90°	0.	0.	0.	0.	0.	0.	0.	
100°	20.5	26.1	32.2	35.2	36.5	38.7	42.4	

11. Pressures and velocities.—A common error is to suppose that a high pressure necessarily means a high velocity. While this is true in many cases, a high pressure which is due to the drying out of a powder-charge does not necessarily mean a higher velocity, and it never means a proportionately higher velocity. For example, with a 1-pdr. powder recently returned to the proving ground for reproof, the original charge had been 72 grammes, I. V. 2100 f. s., with a pressure of less than 11 tons. When fired for reproof the charge of 72 grammes gave a velocity of about 2000 f. s. and a pressure of 17 tons—results which, though abnormal, are instructive.

12. Ignition and inflammation are very important features with smokeless powder, and are directly dependent upon the condition of the burning-surface of the grains; and their contamination in this respect, whether by oil, moisture, grease, or other substances, should be most strictly guarded against. Since the powder for all calibers of naval guns is practically of the same composition, the suitability of a powder for any caliber depends upon the size of grain and the web-thickness. It is believed that, generally

speaking, maximum pressures depend upon surface, and initial velocities upon web-thickness.

13. Forms of grain.—The three forms of smokeless-powder grains in general use in naval guns, from the 3-pdr. up, are the multi-perforated cylinder, single-perforated cylinder, and the strip. The strip is found in some of the older powders for smaller caliber guns, but the short multi-perforated grain is the later form. Recent experiments point to the adoption of a single or multi-perforated stick-powder, the full length of the charge, in guns up to and including the 7-inch, and of half the length of charge in guns above that caliber. In the 3-inch field-piece and 1-pdrs., flake-powders are in general use, but are being replaced by the single-perforated short grain.

14. (1) Small-arm powders.—Several varieties of smokeless powder are used in small-arms; index-numbers are not given to these powders. A nitro-glycerine powder is used in the 30-caliber ball-cartridge; a powder of the Troisdorf variety in the 6 m/m. cartridge; sporting-powder type is used in the 30-caliber and 6 m/m. blank cartridges; revolver-powders are used in the .38-caliber revolver and 30-caliber gallery-cartridges.

(2) The Troisdorf powders are unstable, but this is to some extent due to the method of issue. They are issued in pasteboard boxes, packed in unlined wooden boxes, and are often found to be damp and mouldy. If this dampness penetrates to the powder, it withdraws solvent from it and leaves it in a condition that favors decomposition.

(3) If small-arm ammunition is kept in metal-lined cases, tightly sealed at all times, there is very little chance of decomposition. When decomposition takes place, the acid gases attack the inside of the cartridge-case and the base of the bullet, and may be recognized by breaking down the rounds.

15. (1) Stability of smokeless powder.—Some few cases of decomposition in the older powders have been known, and the cause traced to faulty methods of manufacture.

(2) These defects have been remedied, and there is no cause for apprehension in the new powder being issued. The purity of the pyro-cellulose from which the powder is made and the residual volatiles play the two important parts in the stability or non-deterioration of the powder. It may be stated that from these two features spring the two kinds of dangerous powder which may be designated as *statically dangerous* and *dynamically dangerous*; and, curiously enough, the quantity of volatiles, or the amount

of dryness at which the powder was issued, plays a part in both of these.

16. (1) A statically dangerous powder may or may not at the same time be a dynamically dangerous one, but it is not probable that it will become dynamically dangerous. It may, therefore, be considered alone in the light of a statically dangerous powder, the cause for whose deterioration was originally lack of purification, or which has undergone chemical changes through exposure to heat, etc., thereby giving off nitrous-oxide gases.

(2) The part the volatiles play in this decomposition is a reflex one. If the powder has a tendency to decompose, the dryness of it aids, and, as decomposition goes on, the residual volatiles are absorbed in uniting with the nitrous-oxide gases; and if the rate of giving off gases is greater than that at which the powder can supply volatiles, the evolution of heat is an increasing one. Decomposition may or may not be accompanied by loss of volatiles. It is the giving off of this heat which renders the powder dangerous, from the fact that the process may be so rapid and the radiation of the heat so slow that the ignition-point of the powder may be reached. The ignition-point in good powders is from 350° to 380° F., and in decomposing powder may go as low as 250° F. It is known from experience that small-caliber powders are more liable to decomposition than the larger ones, due primarily to the lesser percentages of volatiles in the smaller calibers; and yet two small-caliber powders first developed their nitrous odors about five months after the detection of a low heat-test.

(3) Statically dangerous powder shows its condition:

- (a) By the heat-test.
- (b) By acid reaction on litmus-paper.
- (c) By smell, which should be the acrid odor of nitrous fumes.

If the decomposition has proceeded so far that nitrous fumes are unmistakably detected by the sense of smell, condemnation should not be delayed. Nitrous odors or visible red-fumes indicate a stage of decomposition greatly more advanced than the early indications shown by a low heat-test. The very deterioration is an evidence of the loss of explosive properties, and so a statically dangerous powder will afterwards become not only not a dynamically dangerous one, but the very reverse—innocuous.

(4) In case of the discovery, or suspected existence, of a statically dangerous powder on shipboard, which has been regularly and periodically examined, it is not believed that it becomes

dangerous so rapidly that it need be condemned at once. Nevertheless, this must not be taken to indicate that precautions may be relaxed and that all directions as to the safety of the ship should not be carried out. Furthermore, it is believed that in the event of a ship being in a position, either by location or because of war, such that it would be impracticable or inadvisable to get rid of the powder entirely, a check to this deterioration can be given by cooling the powder in its air-tight tanks, allowing none of the volatiles to escape. Of course, the first opportunity should be taken to forward a sample to the Proving Ground for analysis.

17. (1) **Dynamically dangerous powders** become so from their drying out and thus becoming more violent; they are seldom *statically* dangerous, and are becoming fewer and fewer in number, from the fact that powders are now issued in a drier condition than formerly, and are packed in standard, air-tight boxes at the factory.

(2) The fact that a powder is becoming dynamically dangerous may be ascertained:

(a) By an increase in initial velocity, as shown by the range.

(b) By the chamber-pressure, as shown by pressure-gauges.

(c) By loss in weight of the charge, always provided the charge had been accurately weighed when first issued and again when the test is made.

(3) In this connection it may be stated that a charge of smokeless powder, as designated by the Bureau of Ordnance, means smokeless powder alone, exclusive of the bag and ignition-charge. Also it would be well for every ship to be provided with a set of *accurate* and *repeatedly-checked* scales.

(4) In the case of strongly suspected drying out of powders, as indicated by loss of weight or otherwise, the Bureau of Ordnance should immediately be notified in order that firing-samples may be ordered sent to the Proving Ground for reassignment of charge.

(5) It is not permitted to alter the weight of charge on ship-board; all powders of earlier manufacture have of late had reassessments of charge, and the newer powders are issued at such a point of dryness and are so packed that alteration of them should not be necessary.

Ballistic Requirements.

18. (1) The following table shows the ballistic results originally required before the velocities of the guns now in service were reduced. For the present tests of powder, however, the same

TABLE E.

A.	B.	C.	D.	E.	F.	G.	H.
Gun.	Length.	Desired charge for original velocity.	Maximum charge allowed.	Maximum working pressure allowed.	Original velocity.	Reduced velocity.	Average weight of charge for column G.
13-inch	35-cal.	295-lbs.	295-lbs.	14-tons	2300	2000	220 to 240
12 "	40 "	350 "	350 "	16.5 "	2800	2700	320 to 340
12 "	35 "	350 "	305 "	14 "	2250	2100	180 to 190
10 "	30 "	300 "	135 "	14 "	2200	2000	110 to 112
10 "	40 "	225 "	240 "	16.5 "	2800	2700	175 to 200
8 "	30 "	59 "	63 "	14 "	2300	2100	62 to 64
8 "	35 "	59 "	63 "	14 "	2300	2100	62 to 64
8 "	40 "	110 "	115 "	16.5 "	2800	2700	100
7 "	45 "	65 "	70 "	16.5 "	2800	2700	63
6 "	30 "	24.5 "	26 "	14 "	2150	1950	21 to 23
6 "	35 "	24.5 "	26 "	14 "	2300	2050	21 to 23
6 "	40 "	24.5 "	26 "	14 "	2400	2150	21 to 23
6 "	50 "	40 "	44 "	15.5-16-ton	2900	2800	38 to 41
5 "	40 "	40 "	44 "	14-ton	2550	2300	12 to 13
5 "	50 "	54.5 "	54.5 "	16 "	2900	2800	23
4 "	40 "	40 "	7 "	7.7 "	14-ton	2300	5.5 to 6.0
4 "	50 "	50 "	15 "	15.75 "	15.5 "	2900	14
3 "	50 "	50 "	5 "	5.5 "	15 "	2800	4.5
"-pdr. all	...	550-gm.	600-gm.	16 "	2240	2240	...
3 pdr. all	...	350 "	400 "	15 "	2200	2200	...
1-pdr. long	...	65 "	70 "	11 "	2100	2000	...
1-pdr. short	...	35 "	40 "	8 "	1450	1450	...
3-inch field	25-cal.	230 "	250 "	11 "	1150	1150	...

* Note.—The I. V. of the 10- and 12-inch, 40-cal. B. L. R. was reduced to 2600 f. s. on February 11, 1905 [2, (9)]; weight of charge for 12-inch about 310 pounds. The 8-inch, 45-cal. has the same weight of charge as that given in the table for the 8-inch, 40-cal.

table still holds, that is, the powder must be of such a nature that it will give the original velocity (column F) with a charge not exceeding the maximum weight allowed (column D) and without exceeding the maximum allowed pressure (column E). A column is appended showing the I. V. assigned to each caliber (column G), and the present service-charges are made up for these velocities (column H).

(2) It is impracticable to include a table showing maximum charge allowed for velocities in column G, since the powder is tested and accepted on the data included in columns D, E, and F.

(3) A curve is drawn from results obtained during the test, and if the powder fulfills requirements (columns D, E, and F), the weights of charges required to give the velocities of column G are taken from the curves. These weights vary considerably for different indices, and are shown in column H.

(4) A good powder will give the old velocity (column F), within pressure-limits (column E), under the following rules:

(a) *For high-powered guns*, weight of charge equals 37 per cent to 42 per cent of weight of projectile.

(b) *For low-powered guns*, weight of charge equals 23 per cent to 24 per cent of weight of projectile.

(5) The reduced velocities (column G), are obtained with the above powders with a weight of charge in the above cases respectively of from 34 to 40 per cent and 21 to 22 per cent of the weight of projectile.

Tests and Cautions.

19. (1) **The potassium-iodide paper-test**, known as the heat-test, has been demonstrated by experience at Indian Head to be as good, if not better, than any other; and this test together with the litmus- and volatile-tests, constitute the principal chemical criteria of both new and suspected powders.

(2) **A litmus-paper test** occasionally shows an acid reaction in powders which afterwards prove to be good, the cause of the acid reaction being that slight traces of acetic acid, evolved by moisture and solvent (the latter escaping from the powder), form, together with cellulose material, such as excelsior used for distance-piece, what might be called a small vinegar factory.

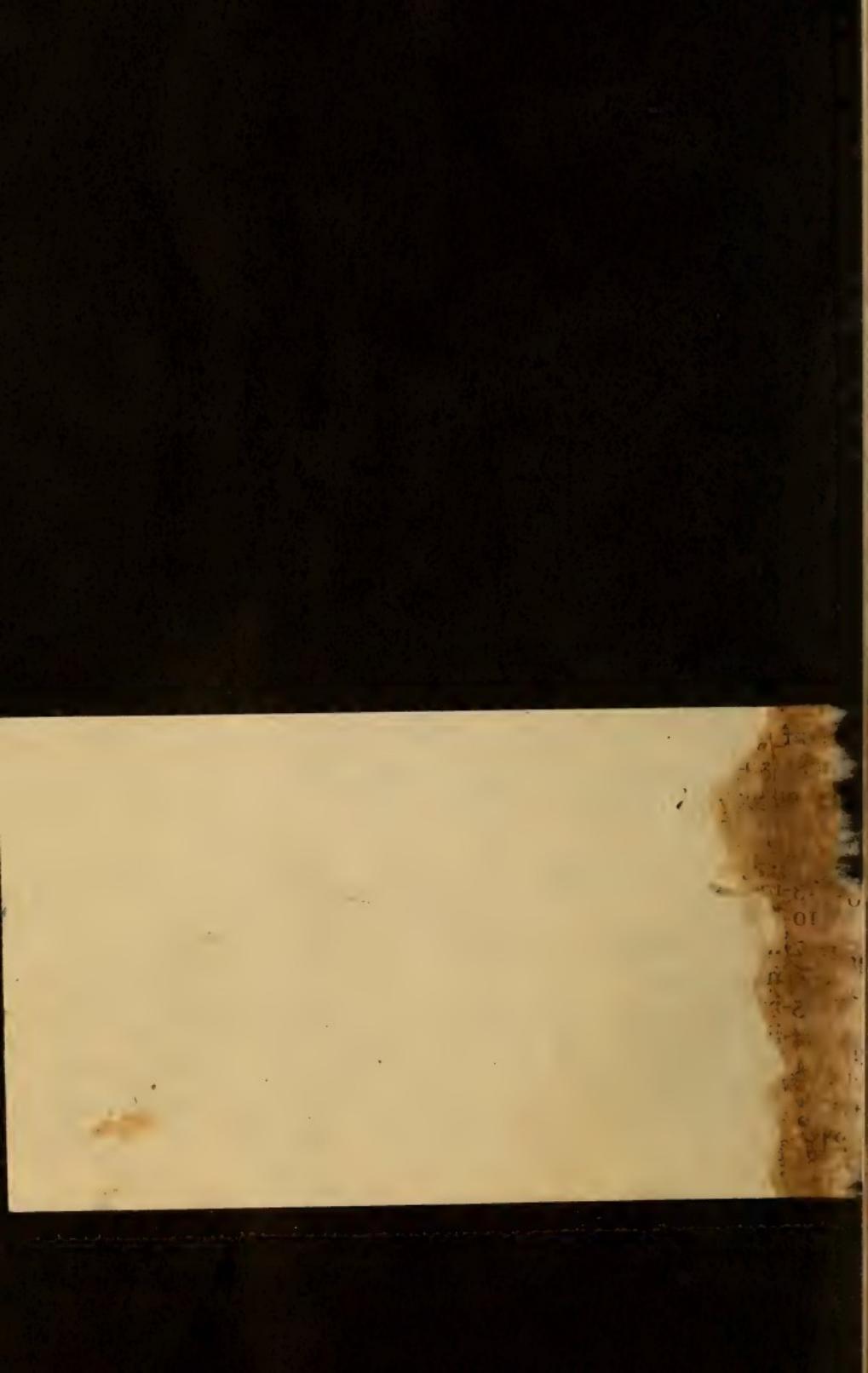
(3) To ascertain roughly whether the above is the case, or whether the powder is really giving off nitrous-acid through deterioration, dry the powder in an exposed vessel at a temperature of about 100° F., for about twenty-four hours, and then make the litmus-test again.

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(2) Weights of Ignition-Charges.

13-inch and 12-inch charges.....	1120 grms.	= 39.5 oz.
10-inch and 8-inch charges	560 "	= 19.75 oz.
7-inch charges	240 "	= 8.46 oz.
6-inch and 5-inch (50 caliber).....	100 "	= 3.5 oz.
5-inch (40 caliber) }.....	60 "	= 2.11 oz.
4-inch (50 caliber) }.....	40 "	= 1.41 oz.
3-inch (50 caliber)	25 "	= .88 oz.



(4) If the odor of ether-fumes is noticeably strong in a magazine, it is evidence that the volatiles are escaping from the powder through leaky tanks, and these should be found and the fault corrected, and the powder watched for increase in pressure.

(5) **Drying powder.**—If for any reason the powder requires to be dried or exposed to the air, the greatest care should be taken not to expose it to the direct rays of the sun for any length of time, as it is known that the actinic power of the sun's rays exerts a deteriorating effect. Powder must never be exposed to a higher temperature than 44° C. (111.2° F.).

(6) The ordnance-officer of every ship should inform himself of the characteristics of the indices of the smokeless powder he has on board, particularly with regard to the chamber-pressure obtained at the Proving Ground when the charge was assigned, as the pressure is the main criterion as to violence.

(7) The subject of the tests of smokeless powder, its storage, and the ventilation of magazines, is given in Navy Department Special Order No. 39, dated April 13, 1903. Nothing that has been specified in these notes should be construed as permitting any lack of thorough, systematic and frequent examinations of all indices on shipboard or in shore magazines.

20. (1) **Ignition-charges.**—Black powder is used for the ignition of all smokeless-powder charges down to and including the 1-inch, 50-caliber gun. The 3-inch field-gun, 6-pdr. and 1-pdr. have no ignition-charges.

(2) Weights of Ignition-Charges.

12-inch and 12-inch charges	1120 grms.	=	59 oz.
6-inch and 8-inch charges	560 "	=	29 oz.
2-inch charges	240 "	=	12.6 oz.
6-inch and 5-inch (50-caliber)	100 "	=	5¼ oz.
5-inch (40-caliber) }	60 "	=	3½ oz.
4-inch (50-caliber) }	40 "	=	2.1 oz.
4-inch (40-caliber)	25 "	=	1.3 oz.

21. Saluting-powder is black, pea-shaped grain-powder, known as cannon-powder. The requirement is that the charge shall be of such size as to give a good report and a fair amount of smoke. Experiments have shown that one and one-quarter pounds is a sufficient saluting-charge for a 3-pdr. or 6-pdr. gun, if properly loaded.

Pressure-Gauges.

22. Outfit.—A pressure-gauge outfit for use on shipboard consists of the following:

Crusher pressure-gauges,
Micrometer-caliper,
Copper gas-check cup,
Copper pressure-discs,
Pressure-tables,
Gauge-wrench,
Drift for working piston and cup,
Short cleaning-rod,
Spare washers, etc.

23. (1) Crusher pressure-gauges are known as cylinder- or mushroom-gauges, depending on whether they are screwed into a special mushroom or placed loosely in the chamber of the gun or cartridge-case. They are also designated as $\frac{1}{6}$ -inch-, $\frac{1}{8}$ -inch-, or $1/30$ -inch-area gauges according to the area of the piston-head. Each area of gauge has its own size of gas-check cup and pressure-disc.

(2) The $\frac{1}{6}$ -inch- and $\frac{1}{8}$ -inch-area gauges are also supplied with three kinds of discs: "no initial pressure," 9-ton, and 15-ton discs—the $1/30$ inch-area gauges being supplied with 4-ton discs. Each lot of discs carries with it a pressure-table constructed for that particular lot of discs, with which lot only can it be used; thus a table of pressures furnished with a certain lot of 9-ton discs cannot be used with a 15-ton disc, or even with another lot of 9-ton discs made from different copper.

(3) The gauges most in use are the cylinder $\frac{1}{6}$ -inch-area, using either 9-ton discs or those of "no initial pressure"—the former for pressures above 9 tons, the latter for those below 9 tons.

24. (1) Directions for use.—Unscrew cap, see gauge thoroughly clean, well-oiled and piston working freely; carefully measure the copper disc about to be used, with micrometer calipers, and note this as the first measurement; place disc on end on top of piston-head in center of pressure-gauge chamber; see copper washer on cap-shoulder oiled; screw on cap; push in piston from other end until disc brings up against cap, put a little oil over head of piston and force in gas-check cup, concave side out, until it brings up against piston; smear tallow over gas-check cup, smoothing it off flush with the end of the cylinder. After firing, unscrew cap,

take out and measure the copper disc carefully, with micrometer calipers, recording this as the second measurement. With the difference between this and the first reading (the compression of the disc) enter the table furnished with this particular lot of discs and obtain the pressure.

(2) If a mushroom-gauge is used the above directions apply, except that the gauge with lead washer is screwed into the mushroom-face, taking care to grease the threads and smear with tallow the surface that bears against the mushroom.

25. (1) **General rules.**—Always use three gauges with each shot.

(2) Examine gauges carefully before and after using for scores caused by leakage of gas.

(3) When gauges are put aside they should be carefully cleaned, and oiled with vaseline.

(4) A gauge that has become scored by gas or expanded or contracted should never be used.

(5) When cylinder-gauges are used in B. L. guns, they should be laid side by side, fore and aft in the bottom of the powder-chamber, just to rear of last section of charge and between it and mushroom-face.

(6) Cylinder-gauges can be used for all calibers, and are recommended in preference to mushroom-gauges.

(7) In rapid-fire guns they should be placed in the bottom of the cartridge-case around primer, and so as to be in *lower* side of case after it is loaded.

(8) In using cylinder-gauges, the gun should be fired at an elevation of 5° to 7° , in which case they will usually remain in the cartridge-case or powder-chamber.

(9) Gauges using the same lot of discs should register within half a ton of each other. Should one of the three gauges register far out from the other two, its pressure should be thrown out in making up the average.

(10) In the 6-pdr., 3-pdr., and 3-inch field-gun, the $1/30$ -inch-area gauges with 4-ton discs are generally used, on account of their small size.

(11) If the pressure expected is near 9 tons, the "no initial pressure" disc should be used, as a 9-ton disc will often show a small compression when the pressure is as low as 6 or 7 tons.

(12) The gas-check cup need not be replaced until it shows signs of breaking up.

Proof of Guns.

26. (1) Before being issued to service all guns are proved by firing at least 5 rounds, two of which are at "proof-pressure," which is always well within the elastic limits of the gun.

(2) The proof-pressures and working-pressures for the different calibers of guns are as follows:

Caliber of Gun.	Length in Calibers.	Proof-Pressure in tons.	Working-Pressure in Tons.
13-inch	35	17 to 18	14 to 15
12 "	35	17 to 18	14 to 15
12 "	40	20	15 to 17
10 "	40	20	15 to 17
10 "	{ 34 30	17 to 18	14 to 15
8 "	35	17 to 18	14 to 15
8 "	45	20	15 to 17
7 "	45	20	15 to 17
6 "	50	20	15 to 17
6 "	30 to 40	17 to 18	14 to 15
5 "	50	20	15 to 17
5 "	30 to 40	17 to 18	14 to 15
4 "	50	20	15 to 17
4 "	40	17 to 18	14 to 15
3 "	50	20	15 to 17
3-inch (field piece)	25	18	11
6 pdrs. {	....	16 to 17	14 to 15
3 "	....	13 to 14	11
1 pdrs. (long)	....	11	8
1 " (short)	....	

GUN-COTTON.

NOTE.—The following notes on gun-cotton are copied from a pamphlet entitled "Gun-Cotton," about to be issued (April, 1905) by the Bureau of Ordnance. The description of the method of manufacture is omitted, and the contents have been somewhat rearranged.

GENERAL REMARKS.

1. (1) **Wet and dry gun-cotton.**—Gun-cotton is known either as dry gun-cotton or wet gun-cotton; the latter being simply dry gun-cotton with 25 per cent of its weight of pure distilled water added. Some war-heads now in the service are made up of wet gun-cotton containing only 20 per cent of moisture. These will be retained at 20 per cent moisture until they are refilled or re-loaded, when enough of the charge will be removed to compensate for the increased weight of water to be added, so that the buoyancy of the torpedo will remain unaltered. In future all wet gun-cotton shall contain 25 per cent of moisture.

(2) **Functions of each.**—Dry gun-cotton is more sensitive than wet, and is more liable to decomposition. Wet gun-cotton is equally as powerful an explosive as dry when detonated, but it can be detonated only by the explosion of dry gun-cotton in immediate contact with it; dry gun-cotton can, on the other hand, be exploded by a charge of fulminate of mercury.

(3) Hence, for reasons of safety, all charges of torpedoes, mines, countermines, and wrecking-outfits, and all gun-cotton carried in bulk, is kept wet, the designated per cent of moisture being 25 per cent.

(4) Dry gun-cotton is carried on board only in primers for the wet-charges; when these primers are used, some of the blocks of wet gun-cotton are dried as described below.

Specifications for Manufacture.

2. The following are the latest specifications for the manufacture of gun-cotton for the U. S. Navy:

(1) All gun-cotton is to be of the maximum possible nitration, containing in no instance less than 13.2 per cent of nitrogen.

(2) All blocks are to have the maximum density possible, but in no case less than 1.3 per cent when containing 25 per cent of moisture; or the weight of a cubic inch of dry gun-cotton, when pressed into a block, shall not be less than 0.6 ounce.

(3) The gun-cotton is to be washed free from the alkali used in its purification. No carbonate of soda or other alkali is to

be added to the finished pulp. The addition of mercuric-chloride solution to the gun-cotton is also forbidden.

(4) The gun-cotton shall stand a heat-test at 65.5° C. for forty minutes without showing signs of decomposition.

(5) The gun-cotton, containing 15 per cent of moisture, is to be delivered f. o. b. cars at the works of the manufacturer, packed in zinc-lined wooden boxes, with covers fitted with rubber-gaskets to make the boxes air-tight, and to be of convenient size.

(6) The gun-cotton blocks shall be pressed into the following sizes, or such other sizes as the Bureau may direct:

(a) *For naval-defense mines:* In blocks 2.9 by 2.9 by 2 inches, without central perforation.

(b) *For torpedo war-heads:* In blocks 8½ by 8½ by 2 inches, without central perforation.

(c) *For primers:* In blocks 2.9 by 2.9 by 2 inches, with 9/16 inch central perforation, piercing the 2.9 by 2.9-inch faces of the blocks.

Form and Dimension of Blocks.

3. (1) The different forms in which gun-cotton is made, depend upon the particular use for which it is intended.

(2) For the charge of mines, countermines, and wrecking-outfits the gun-cotton is made in the form of blocks 2.9 by 2.9 by 2 inches, without central perforation.

(3) For filling war-heads of torpedoes, gun-cotton is made in the form of blocks 8½ by 8½ by 2 inches, without central perforation.

(4) For the dry-primers of naval-defense mines, and wrecking-outfits, gun-cotton is made in blocks of the same dimensions as the blocks used for the wet-charges of these mines (see Art. 3, Par. 2).

(5) For the dry-primers of countermines, gun-cotton is at present made in the form of cylindrical blocks, 2 inches in height and 3½ inches in diameter, with a central perforation of 9/16 inch in diameter.

(6) For the dry-primers of automobile-torpedoes, the gun-cotton is made in the form of cylindrical blocks, 2 inches in height and 1 11/16 inches in diameter, with a central perforation of 9/16 of an inch in diameter.

DRY GUN-COTTON.

Packing and Stowage.

4. (1) The glass jars for dry-primers, filled with dry gun-cotton, are put in wooden cases, varnished to correspond with the interior woodwork of the ship.

(2) **Where stowed.**—When received on board ship, these cases are stowed in different parts of the ship, never below the water-line. They should be kept as near the upper deck as possible, so that they may readily be thrown overboard in case of fire, but should not be exposed to the direct rays of the sun, nor to the weather.

(3) **How shipped.**—On account of insurance restrictions imposed on freight companies, it is often impracticable to ship gun-cotton in its dry state. When this is the case, gun-cotton primers may be issued wet in proper packages, from which, on receipt on board ship, they are to be removed and dried and then stowed as laid down for dry-primers.

Rules for Drying Gun-Cotton.

5. (1) Wet gun-cotton primers may be dried by either of the following methods:

- (a) Exposure in a steam-drier.
- (b) Exposure in a dry atmosphere.

(2) The quantity of dry gun-cotton primers that is furnished being very small, the stock is to be replenished as fast as expended by drying the wet blocks which are removed from the torpedoes in priming them.

6. (1) **Drying by exposure in a steam-drier.**—The steam-drier must be placed above the water-line, remote from fires and lamps, and in such a position that it will not be subject to disarrangement. Its supply of steam is to be derived from a suitable part of the steam-heating apparatus of the ship, or from any convenient source of low-pressure steam-piping at a navy yard.

(2) The blocks are to be dried, weighed separately, and the weight of each is to be marked on the block with a soft lead-pencil (never putting labels of any kind on the gun-cotton). The blocks are then to be strung on the rods, with the iron washers between them, and placed in the baskets of the drier. The baskets are placed in the drier, the door closed, the thermometer put in place, steam turned on, and the ventilating openings are adjusted.

(3) The baskets, rods, and washers must be kept free from dirt and oil.

(4) The temperature of the drying-chamber must not exceed 100° F.

(5) After each day's heating the blocks are to be removed carefully and weighed; the weights are to be marked on the blocks, and the drying is then continued. This process is to be repeated until the blocks no longer lose weight, when all but a small percentage of moisture will have been expelled.

(6) When the drying is completed the blocks are to be removed from the drier and placed, while still warm, in the glass jars, with strips of blue litmus-paper between them. The jars are to be closed tightly, and the gun-cotton is then to be stowed and inspected as dry gun-cotton.

7. (1) **Drying by exposure in a dry atmosphere.**—String the blocks to be dried on a wood, brass, or copper rod or pipe, which must be free from dirt and oil, or place them on a shelf made of wire-netting, separating the blocks from each other to expose all surfaces freely to the air; suspend the rod or shelf in some suitable place, not in the vicinity of the galley or other fires, where the blocks will be freely exposed to the air and be under cover.

(2) Expose the blocks only when the atmosphere is dry; at all other times keep them in an empty powder-tank, in the immediate vicinity of the place selected for drying, kept closed to exclude moisture. Weigh the blocks every two days, noting on the blocks the date and weight with a soft lead-pencil. Continue the drying until the blocks show no loss of weight for two consecutive weighings, the weather being moderately dry. Then place the blocks in the glass jars, with strips of blue litmus-paper between, and treat them according to the rules given for dry gun-cotton primers.

(3) Avoid unnecessary handling of the blocks, as they are apt to flake and crumble.

Care of Gun-Cotton.

8. (1) **The gun-cotton magazine** should never be allowed to attain a temperature as high as 100° F. for any great length of time.

(2) **Direct rays of the sun.**—Avoid as much as possible exposing any box or case containing gun-cotton, either wet or dry, to the direct rays of the sun for any length of time, as the temperature inside the box can in this way be raised to a point consider-

ably above that of the open air, and this temperature will be maintained for a considerable time after the exposure.

(3) **Diurnal changes of temperature** will not affect gun-cotton, wet or dry, provided the cases or boxes containing it are not exposed to the sun.

(4) **The dry gun-cotton primers** supplied to ships are packed in glass jars with tight covers to exclude moisture. Strips of blue litmus-paper are placed between the blocks of dry gun-cotton.

(5) **The glass jars** are to be kept in their wooden cases, and both jars and cases are a part of the permanent outfit, and must be cared for and turned in as such.

(6) **In stowing the dry-primers** care should be taken that the cases are not too near each other. The explosion of a single primer would probably not detonate other dry-primers unless they were within 10 feet of the exploding primer. Dry-primers must not be stowed in the vicinity of the galley or other fires, nor too near the guns of the battery.

(7) **In removing from their cases** the glass jars holding the dry gun-cotton, never expose them to the rays of the sun, as the glass may act as a lens and cause ignition.

(8) **The separation of boxes** of dry gun-cotton primers by a distance of 10 feet will prevent the danger of a fire on board ship being communicated directly from one box to another, thus spreading and increasing the intensity of the fire. Under ordinary conditions, small quantities of dry gun-cotton will not be detonated by influence at distances greater than 3 or 4 feet.

(9) **Dry gun-cotton should be stowed above the water-line.**—This precaution is taken so that the explosive will not become damp by the absorption of moisture, and thus be too wet to detonate when required for use, and also as a measure of safety to the ship.

(10) **Stability.**—Dry gun-cotton, when kept out of sunlight and not exposed to a temperature above 105° F., does not deteriorate, if properly made. All gun-cotton issued to vessels is tested immediately before it is shipped from the torpedo-station, and none whose test is low is allowed to be issued.

(11) **Effect of heat.**—Dry gun-cotton, when brought into contact with a flame or with any material heated above the ignition-temperature of the cotton, burns rapidly with a yellow flame, and is quickly consumed. Small quantities, such as are contained in dry gun-cotton primer-jars, will not detonate under these conditions. In order to produce a detonation, the gun-

cotton would have to be confined and the entire mass brought to the ignition-temperature at once.

INSPECTION OF GUN-COTTON.

9. The following inspections of gun-cotton must be regularly made, and the results entered in the ship's log:

Weekly: All dry gun-cotton.

Monthly: All dry gun-cotton.

Quarterly: All wet gun-cotton.

Dry Gun-cotton.

10. (1) **Weekly inspection.**—All dry gun-cotton primers must be inspected weekly. This is to be done, without opening the glass jars, by observing the condition of the blocks and the strips of blue litmus-paper placed between them.

(2) **Signs of decomposition.**—In the event of any serious decomposition having taken place, the gun-cotton will be found more or less covered with pasty, yellow spots, the jar will be filled with brownish-red highly acid fumes, and the litmus-paper will show a decided red color.

(3) **If the gun-cotton is actually decomposing,** it should be thrown overboard, after a sample block has been set aside for reference. This sample should be placed in a clean glass bottle, be wet thoroughly with pure water, and the bottle closed tightly. At the first opportunity, it should be forwarded, with a full statement of the facts, direct to the Naval Torpedo-Station, Newport, R. I., in order that its condition may be examined carefully and that the diagnosis made on board ship may be verified, and a copy of the statement of facts will be forwarded at the same time to the Bureau of Ordnance.

(4) **No gun-cotton is to be thrown overboard** unless a board of experts has pronounced it to be in the condition above described. This caution is very important, as considerable valuable gun-cotton has been condemned and destroyed, and a sense of insecurity has arisen in consequence of errors of inspection.

(5) **It frequently occurs** that the blue litmus-paper becomes faded by exposure in jars, but no danger is to be apprehended in consequence.

(6) **If the litmus-paper has become reddened**, but no fumes or pasty spots are observed, the block should be lifted out by the loose ends of the tape and placed on a perfectly clean, dry piece of blotting-paper. Then untie the tape and separate the blocks,

being careful not to touch them with the fingers. (A perfectly clean, dry crash towel may be used in handling the blocks.) Remove the strips of litmus-paper, insert freshly-moistened strips in their places, and tie the tape as before. After an hour's interval, examine the ends of the strips of litmus-paper.

(7) If the strips of litmus-paper have become reddened, replace the blocks of gun-cotton in the jar, wet them thoroughly with pure water, and at the first opportunity forward the jar and its contents to the Torpedo-Station. In this latter case none of the gun-cotton is to be thrown overboard, as there is a much greater chance for error in inspection.

(8) If the moistened strips of litmus-paper have not become reddened after one hour's exposure, replace the blocks in the jar, close it tightly, and replace it in its box.

11. (1) Monthly inspection.—Even if no change is observed in the litmus-paper at the weekly inspection, the test just described, with freshly-moistened strips of blue litmus-paper, is to be applied to all gun-cotton once each month; this constitutes the monthly and quarterly inspections.

(2) In case the gun-cotton is decomposing, the procedure described under weekly inspection is to be adopted.

Wet Gun-cotton.

12. (1) Quarterly inspection.—The wet gun-cotton is packed in the torpedo war-heads or in the mine-charge cases or counter-mines, etc., and the weight of the wet cotton and its containing-case is stamped on the case. The cotton contains as nearly as possible 25 per cent of water. These cases are again packed in stowage boxes, and the gross weight of wet gun-cotton, war-head (or mine-charge case), and stowage box are stamped on the outside of the box. The stamping of the gross weight on the outside of the stowage box is a new practice; ships having outfits in which it has not been done should have it done immediately. The object is to avoid removing the war-heads, etc., from the stowage boxes for the quarterly weighing.

(2) The cases are to be weighed separately every three months, and any loss in the gross weight is to be made up by the addition of pure distilled water, poured through the filling-hole, which is then to be closed carefully.

Precautions to be Taken in Inspections.

13. (1) Do not handle the gun-cotton with the bare hand.
(2) Never touch litmus-paper with the bare hand. Blue lit-

mus-paper may become reddened by acid substances exuded from the skin. Litmus-paper should always be handled with forceps, provided in the chemical box.

(3) **Always moisten litmus-paper** before making the test, using the distilled water provided in the chemical box.

(4) **Hold the litmus-paper in the forceps**, dip one of the glass rods, provided in the chemical box, in the bottle of distilled water, and then apply the moist rod to the paper. The litmus-paper should be moist only, and not flooded with water. Should the supply of water in the chemical box be exhausted, water distilled on shipboard, or fresh rain-water may be used, provided it has been tested and found free from acid reaction.

(5) **Make a comparative test** to prove the absence of an acid reaction. As blue litmus-paper may sometimes appear slightly red when moistened with distilled water only, a comparison should always be made by taking two pieces of fresh paper and moistening one with distilled water and the other with dilute vinegar.

(6) **Always examine the test-papers by a white light**; litmus-paper will present a reddish appearance in any apartment that is shellacked or colored; the examination of test-papers should therefore be made only in a well-lighted room or in the open air.

(7) **Do not mistake iron-rust** for pasty, yellow spots. Gun-cotton sometimes becomes rusted in the course of manufacture, or from the case in which it is packed. The rust does no harm.

(8) **Avoid unnecessary handling of the blocks**, as they may flake or crumble.

WAR-HEADS FOR TORPEDOES.

General Description.

14. (1) **A war-head** complete consists of the charge, the primer, and the detonator.

(2) **The charge** is the wet gun-cotton contained in the head. The weight of the charge is its actual weight when wet.

(3) **The primer** is the dry gun-cotton which is used to detonate the charge. The weight of the primer is its actual weight dry; it is approximately 1 lb. 6 oz.

(4) **The detonator** is the fulminate of mercury mixture used to detonate the primer. The percussion detonator is always used in automobile-torpedoes.

(5) **Weight.**—The gross weight of the shell and of the enclosed

charge, when at required moisture, is stamped on the bulkhead of the war-head.

(6) **Stowage.**—The war-heads are stowed in the torpedo-head room, which is arranged for flooding in the same manner as other ammunition-rooms.

Method of Loading.

15. (1) When small blocks are used, a number of them are arranged side by side on a metallic template, the block from which the primer has been cut in the center. The parts of blocks which project over the ends are cut off by a band-saw, the proper curvature being given by tilting the table on which the template rests.

(2) When blocks $8\frac{1}{2}$ inches square are used, the upper layers are made from a single block, which is fitted around the primer-case. The lower layers are made by putting four blocks on a template and sawing off the projecting parts, and the parts sawed off are used to fill in the layers nearer the top of the war-head. The use of this size and form of block does away, to a great extent, with the scrap which results when small blocks are used for loading, and also gives a greater density of loading.

(3) Foreign torpedoes are loaded with blocks in the form of sectors around the central primer-block, which is round and about 3 to 4 inches in diameter. The sectors are of greater radius in the layers near the base of the war-head than those at the top, and are made by compressing the gun-cotton pulp in molds which have been made to conform to the shape of the war-head. A great number of molds are required and the gun-cotton is packed in the head without any change after it comes from the final press. Such blocks are suitable only for one style of war-head. It is much more economical, however, to have one form of slab or block of gun-cotton, which, by sawing, can be adapted to any war-head.

(4) There are nine or ten layers of gun-cotton in the war-head of the 3.55-meter and 5-meter torpedoes, with the exception of the 5-meter Mark I. This war-head contains seventeen layers. The dry weight of gun-cotton in the former is 95 to 100 pounds; in the latter it is 175 to 180 pounds.

(5) The question of molding the charge for the war-head in one solid piece, as it is said to be the custom in some foreign navies, is contemplated. This method will be adopted in our navy if found practicable.

MINE-CHARGES.

16. (1) **Mine-charges**, four of which are supplied for each naval-defense mine, contain fifty-four blocks of gun-cotton, 2.9 by 2.9 by 2 inches, including the four blocks which form the dry-primer.

(2) **Wrecking-outfits**.—This mine-charge is also used in wrecking-outfits in connection with a Farmer's-machine, and 300 to 500 feet of leading-wire.

(3) **Mine-cases are loaded** with four charges, their size and shape being such that no cutting or trimming of the gun-cotton is necessary.

(4) **Countermines are loaded** with either compressed gun-cotton blocks (see Art. 3, Par. 2), or with scrap or pulp gun-cotton.

(5) **Dummy mine-charges**.—Four dummy mine-charges are supplied with each outfit, each of which contains fifty-four blocks of wood of the same dimensions as the blocks of gun-cotton used in the live mine-charges. These dummies are painted white, and are marked "Dummy," on all four sides, with black paint.

(6) **Accessories to mine-outfit**.—Forty-six dummy detonators, 130 fuse-bridges, and 130 live, electric-detonators are furnished with each mine-outfit of twelve naval-defense mines and one dummy.

PRIMERS.

17. (1) **Definition**.—The detonating-charges of dry gun-cotton which are used to explode the charge of wet gun-cotton are designated *primers*. The fulminate of mercury igniters, used to detonate the primers, are known as *detonators*.

(2) **Dry-primers for automobile-torpedoes** are packed in glass tubes enclosed in wooden boxes, strips of litmus-paper being placed between the discs. The glass tubes are closed at each end by wooden covers with rubber washers. They must be stowed above the water-line in a cool, dry, secure place as far as possible from the guns. When more than one box is supplied, the boxes should be stowed apart.

(3) **Dry-primers for mines** are packed in cylindrical, glass jars, fitted with cork covers, each jar having a capacity for six blocks, 2.9 by 2.9 by 2 inches, with central perforation, and with litmus-paper between them. Each jar is fitted in a wooden case, having a sliding cover painted white, and is stenciled with contents and

with precautions. They are never to be stowed below, but must be placed in different parts of the ship above the water-line.

(4) **Wet-primers for automobile-torpedoes** when issued are packed in brass tubes, enclosed in wooden boxes. Stamped on the cover of the tube is the gross weight of the tube and primer. They contain 25 per cent moisture, and are stowed where most convenient, though never near the dry-primers or detonators.

DETONATORS.

18. (1) **Detonators** are of two kinds, percussion and electric.

(2) **Electric-detonators** are used in mines which are to be fired by an electric-current; in countermines and in wrecking-outfits.

(3) **Percussion-detonators** are used in automobile-torpedoes and contact-mines.

Electric-Detonators.

19. (1) **Electric-detonators** are cylindrical, copper cases containing 35 grains of fulminate of mercury, primed on top with dry, pulverized gun-cotton.

(2) A plug is made of one part of ground-glass and two parts of sulphur melted together, cast around the detonator legs. These legs are tinned copper-wires, No. 20 A. W. G., 6 inches in length, insulated with a double layer of cotton-thread soaked in paraffine, the outer layer colored red.

(3) The inner legs of the detonator are bridged by a platinum-iridium wire, 90 per cent platinum, 10 per cent iridium, $3/16$ inch long and 2 mils. in diameter, having a resistance of $.65 \pm .03$ ohm.

(4) **Color.**—Electric-detonators are painted red, and are for use with naval-defense mines, countermines, wrecking-outfits, etc.

(5) **Sensitiveness.**—Electric-detonators for mines are issued in boxes containing eight. If one detonator should be exploded accidentally all the other detonators will explode. There is reasonable assurance that if one box of detonators explodes, another at the distance of one foot will not explode if it is protected from the flying fragments of the exploded detonator-cases.

(6) **Blocks for electric-detonators** are wooden cylinders. The detonators are placed in holes around the circumference, the cover locking them in. The blocks are placed in a covered, tin cylinder, painted red and marked "Dangerous."

(7) **Where stowed.**—They are stowed in different parts of the

ship, preferably in the tops, but never below the water-line or near any explosive.

Percussion-Detonators.

(1) **Percussion-detonators** are cylindrical, copper cases, containing 35 grains of fulminate of mercury, and are primed on top with dry, pulverized gun-cotton. They are closed at the bottom and have in the top a fulminate-cap, connecting by means of a small channel with the interior. An anvil which rests on this cap detonates it when struck, and this in turn detonates the fulminate-charge.

(2) **Color.**—Percussion-detonators are painted red, and are supplied for use with automobile-torpedoes (Fig. 1).

(3) **Boxes for percussion-detonators** are made of cork-forms which fit tightly in tin boxes and have holes for the detonators. The lid of the box is lined with cork and closes tightly on the heads of the detonators, thus preventing any motion.

(4) **Where stowed.**—They are stowed in different parts of the ship, preferably in the tops, but never below the water-line or near any explosive.

TORPEDOES.

NOTE.—The following chapter is taken from "Gun and Torpedo Drills, 1900," and has been but slightly revised.

Owing to the large number of changes and improvements now in progress in torpedoes and torpedo appliances, no attempt has been made to include descriptions of the latest devices, or instructions in regard to their use. These later devices consist principally of the following:— $5M \times 45c/m$, Mark II torpedo; $5M \times 45c/m$, Bliss-Leavitt torpedoes, Mark III and IV; $5M \times 21$ -inch, Bliss-Leavitt, Mark I torpedo; gyro-gear, Marks II and III; submerged tubes, accessories, spare parts, torpedo-directors, etc.

This fact, together with the fact that much valuable information in regard to the handling of torpedoes will result from the torpedo practice now required, will necessitate a complete revision of this subject in the next edition. The instructions in this chapter are therefore applicable only to the 3.55-Meter torpedoes, Mark I, II, and III, and to the 5-Meter torpedo, Mark I. For instructions on the more recent torpedoes mentioned above, reference must be made to the special descriptive publications thereon, issued by the Bureau of Ordnance.

ORGANIZATION OF THE TORPEDO-DIVISION.

1. (1) The torpedo-division will, when practicable, be composed of the following officers and men:
 - (2) The torpedo-officer, in charge; he may be an assistant to the officer who is in command of powder division.
 - (3) One junior-, warrant-, or petty-officer (first-class) in each torpedo compartment, in immediate charge of the compartment.
 - (4) One junior-, warrant-, or petty-officer (first-class) at each torpedo-director. Where directors are installed in torpedo-compartments the officer-in-charge of compartment takes station at director when the torpedoes are ready to be fired.
 - (5) One gunner's-mate or seaman-gunner at each torpedo air-compressor who will go to station as directed when accumulators and torpedoes are charged.
 - (6) One gunner's-mate or seaman-gunner in each torpedo store-room.
 - (7) One torpedo-crew (4 men) for each single tube, or for each pair of tubes on opposite sides of deck in the same compartment, or in close proximity.
 - (8) Where a pair of tubes is worked by a single crew, one torpedo and tube is prepared for action, then the other. The crew will not divide until both torpedoes are ready to fire. 1 and 3 will then tend at starboard tube of a pair, and 2 and 4 at port tube.
 - (9) In the case of submerged tubes, the above general system of organization will be followed as closely as circumstances permit.

2. (1)

Torpedo-Crew.

(4 men.)

No.	Title.
1	1st torpedo-man
2	2d torpedo-man
3	1st tubeman
4	2d tubeman

(2) A *torpedo-crew* consists of four men, two of whom should be gunner's-mates or seamen-gunners. The crews must combine, when torpedoes are to be transported for long distances, and whenever torpedoes are to be hoisted on board after exercise. The crew of a torpedo are not boarders or riflemen.

(3) The duties of 1 and 2, who are designated "torpedo-men," are confined as far as practicable to the more skillful operations connected with the preparation and adjustment of the torpedo itself; while the duties of 3 and 4, designated "tubemen," are chiefly connected with transporting and handling the torpedo and its appliances, and preparing the tube and its appurtenances for use. They will, however, always assist 1 and 2, when not engaged at their special duties.

(4) *Arms for torpedo-division.*—At general quarters the officers of the torpedo-division will be armed with the service belt and revolver. The members of the torpedo-crew will not be armed.

(5) Torpedo-tubes will be designated according to the rule used for guns in the ship's battery.

TO PREPARE FOR ACTION OR EXERCISE.

3. (1) There is so much detail work and so many adjustments required in the preparation of torpedoes for firing, that no rigid drill is practicable. Thoroughness is essential, and there must be no undue haste which may result in errors or omissions. The effort should, however, be made by the torpedo-officer to so assign and correlate the details of preparation among the members of the torpedo-crew that no time will be lost. Torpedo installations, whether overwater or underwater discharge, vary in so many particulars that the best system of transporting, charging, and loading must be worked out to suit each case. For this reason, no hard and fast rules are laid down, and the general instructions which follow may be modified as circumstances require. But the following general rules always apply:

(a) All adjustments should be verified and checked off as they are made, upon a list provided at each tube, in order that there may be no omissions.

(b) One man, the officer-in-charge of the compartment, if practicable, should do this at each tube; if not, the 1st torpedo-man must verify and check the details performed by the 2d torpedo-man.

(c) The torpedo-officer, having this latitude and choice of action, is directly responsible for the results attained as to time consumed in preparation and torpedo performance.

(2) If the torpedo is in the tube with appropriate head affixed, air-flask charged to prescribed pressure, and mechanism in good order, the officer-in-charge commands: 1. *Torpedo (No. —)*, 2. PREPARE FOR ACTION (or EXERCISE)! He then designates the range, depth, and pressure.

(3) At this command the junior-officer (or petty-officer) stationed at the torpedo-director provides and places director.

(4) Seaman-gunner in charge of air-compressor starts compressor and charges accumulator to limit of working pressure.

(5) 1 provides pressure-gauge and charging-pipe; opens tube door and assisted by 2, seizes horizontal tail-blade and hauls back tube to charging position (if the torpedo sticks, places the tail-line around the tail forward of the blades and mans that); screws pressure-gauge on charging valve-seat, and ascertains pressure in flasks; if not sufficient, removes gauge and connects the flask with the accumulator by charging-pipe; when accumulator-gauge indicates the desired pressure, disconnects the pipe; reads the pressure in air-flask again, by again shipping gauge.

(6) 1 then examines and corrects, as needed, the following adjustments according to adjustment sheet, or specific order; first testing distance-gear and locking-device if desirable:

(a) Tests throw of horizontal-rudder, noting that it moves freely.

(b) Sets regulator-spring.

(c) Sets distance-gear sector, being careful to have cam-pin against the stud on the sector.

(d) Sets depth-index and locks it.

(e) Locks the rudder for both position and duration.

(f) Sees water-tripper raised.

(g) Sees drain-plugs in (or after one out, for war-shot).

(h) Fills oil-cups of valve-group, engine, gear-box and tail; also oils all rudder-connections and water-tripper.

- (i) Sets vertical-vanes.
- (j) Sees vertical-rudder free (locked if Obry is not used).
- (k) Winds the Obry-gear (now called Gyro-gear, Mark I).
- (l) Opens the stop-valve.
- (m) Examines for air leaks.

Sees all ready and then commands **SHOVE HOME!**

(7) 2 provides tool-box, washer-box, and tapers; raises tripping-latch and pins it; assists 1 to haul back torpedo; opens stop-valve; takes out charging-plug; assists 1 with charging-pipe; tends accumulator-valves; replaces charging valve-plug, when flask is fully charged. Fills all oil-cups (stop-valve being closed); sees that firing-lever is cocked.

(8) 3 removes railing and stanchions in wake of train of tube; takes off tube-cover; clears away tube; eases clamps of tube-mount; trains tube to charging position; clamps tube-mount; clears away port-shutter; sees that it works smoothly, and closes it; provides nose-line, tail-line with exercise head (depth- or rolling-register, if to be used), or war-nose and dry gun-cotton exploder; assists to haul back torpedo, if needed.

(9) 4 assists 3 in above mentioned duties of tube; provides loading-staff, can of sperm-oil, cleaning-staff and waste; belt for 1 fitted with a box of primers; provides impulse-charge, and places it in chamber; assists to haul back torpedo, if needed.

4. (1) **To shove home.**—1 places loading-staff against propeller-shaft, and assisted by 3 and 4, shoves torpedo in tube until guide-stud brings up gently against the stop-pin.

(n)* Takes off lock (and rudder-index, if used) and turns propeller till notch on main shaft shows that the engine is not on center (between dial positions of 5 and 7 o'clock); closes the door of tube, and brings torpedo to the point of train most convenient for inserting war-nose, and reports "Ready for Priming."

(2) 2

(o) Works cocking-lever to relieve stop-pin from jamming, and insure that lever has full throw.

(p) Releases tripping-latch, and tries its spring.

(q) Enters dry gun-cotton primer and screws in practice-nose; this may have to be done before the torpedo is shoved home.

* The sequence of letters, beginning with (a), (b), etc., Art. 3, (6), is maintained regardless of paragraphs, so as to show the sequence of adjustments to the torpedo.

(r) Attaches exploder to war-nose, and sees the latter ready for use.

5. (1) **To prime.**—The torpedo is trained to position convenient for placing war-nose.

(2) 2

(s) Removes practice-nose; screws in war-nose with its exploder; sees fan run forward (when exploder is attached to it).

(3) 1

(t) Inserts primer and connects firing-mechanism, placing safety-pin in position.

(4) 3 and 4 trice up port-shutters, if any.

(5) Fixed torpedo-tubes and tubes pivoting in ship's side should have (sliding-trap) door fitted in outboard end of tube to allow this adjustment. If not so fitted, torpedo is hauled to rear of tube, and 2 inserts war-nose; 1 sees propeller-lock on during this operation.

(6) If torpedo is well protected, the war-nose may be inserted at command PREPARE FOR ACTION! If not, the commanding-officer may decide to prepare the torpedoes for firing, except priming. In this case he will direct the torpedo-officer, who keeps in communication with him, when to insert primers.

(7) Upon receipt of command, 1. *Torpedo (No. —)*, 2. COMMENCE FIRING! the torpedo-officer will fire at his discretion, or direct the officer at torpedo-director to do so as the sights bear.

6. (1) **To point.**—The torpedo-officer indicates the number of degrees of train, and the amount of depression, if the latter is to be adjusted. The officer at director sets it for courses, speeds, and distance, when notified by the torpedo-officer.

(2) 3 and 4 see port-shutters clear, assisted by 1 and 2, if needed; then train and elevate tube as directed.

(3) 1 directs train and elevation and reports "Torpedo (No. —) Ready!" when on designated train and elevation.

(u) Removes safety-pin from trigger.

7. **To fire.**—The torpedo may be fired directly by the officer at the torpedo-director, using an electric firing-apparatus. Or the command to fire may be given by the torpedo-officer, or the officer at the director, and executed by 1.

8. (1) **To take out primers.**—1 breaks the connection of the firing-mechanism, or places safety-pin.

(2) 3 and 4 train tube to position for removing war-nose.

(3) 2 removes war-nose (and inserts practice-nose).

9. (1) The tubes.—In working a pair of tubes, Nos. 3 and 4 will train, and Nos. 1 and 2 fire at order.

(2) The behavior of the tube and its attachments will be noted at discharge, and as soon as the torpedo is launched, the ports will be closed by Nos. 3 and 4, and the crew will proceed to get another torpedo into the tube, ready for launching, or to receive the launched torpedo from the boat sent to recover it.

10. (1) To secure.—The officer in charge commands SECURE!

(2) Each member of the crew secures what he cast loose, and returns what he provided, and then falls in at this station.

(3) Crew and supernumeraries will hoist in, strike below, and restow torpedoes after practice, and return handling- and transporting-gear.

PREPARING TORPEDOES FOR FIRING.

11. The following steps in preparing a torpedo for firing, presupposes that all parts of the torpedo-mechanism are in good order and that each part properly performs its function.

Whitehead Torpedoes.

12. Precautions.—Always keep stop-valves closed and starting-lever forward, except when using air. The lock is to be habitually kept on the propeller.

13. Preparations.

(a) Try tripping-latch and stop-pin, and be careful that stop-pin is down with safety-pin in place before entering the torpedo. Enter torpedo into tube until the forward guide-stud just enters the guide-slot.

(b) Remove charging-valve of torpedo, open stop-valve, screw in wing-nut of charging-pipe, and charge flask to about 700 pounds for testing.

(c) With starting-lever back, test all air connections, engine- and valve-plugs, etc., for leaks, using a lighted taper.

(d) *Put a little oil in the cups; oil after bearings; take off propeller-lock; raise water-tripper; and then test distance- and locking-gear by running the engines, placing a tarpaulin to catch the oil blown through. Put on the propeller-lock. In making this test, set distance-gear sector for one tooth and give the regulator-plug about two turns down from flush position, for all marks of torpedoes. To lock the rudder: in 3.55 m., Marks I. and II., push down the ratchet-bar two teeth, by means of tool No. 9, through a hole in the top of*

the shell of the torpedo; in 3.55 mm., Mark III., and 5 m., Mark I., using tool No. 46, turn the locking-adjustment index two graduations to the left and clamp it; then turn the outer bevel-gear sector to the left until the tool brings up against the index.

(e) *See that propeller-lock is on.*—Test horizontal-rudder for full throw by hand and by steering-engine. See that it works freely. This test is the same for all marks of torpedoes except that, with 3.55 m., Marks I., II., and III., use tool No. 40 with permanent scale on after vertical blade, and with 5 m., Mark I., use tools No. 44 and No. 45. With air on the engine, and with tool No. 9 (for Marks I. and II.), and tool No. 10 on adjusting-nut (for Mark III., and 5 m., Mark I.), inserted through hole in the side of the shell of torpedo, move the valve-stem of the steering-engine back and forth to its limit. The throw of the rudder should be at least four (4) divisions down and three and one-half ($3\frac{1}{2}$) up.

(f) *Test horizontal-rudder for effect of hydrostatic piston* and get correct difference of throw. The *down*-throw due to piston *out* should exceed by about one-fourth of a division the *up*-throw due to piston *in*. To test piston: in Mark I., enter tool No. 36 in hole on starboard side of torpedo, bring the bent arm against the after-face of the piston, and with starting-lever aft, and depth-index registering 5 feet, press down to obtain *up*-throw and release pressure to obtain *down*-throw of rudder; in Marks II. and III., and 5 m., Mark I., using tool No. 37, turn operating-spindle of depth-index to the left until it binds, for piston *in* and *up*-throw; turn it to the right until the index registers a depth of 5 feet, for piston *out* and *down*-throw of the rudder. To get correct throw, use the valve-star in Marks I. and II., and the adjusting-screw in Mark III. and 5 m., Mark I.

14. (1) *Obry-gear.*

(g) *Adjust Obry-gear* and put same in place in the torpedo, and make sure that the vertical-rudders work freely and give proper throw. To adjust the Obry-gear: screw the gear to the adjusting-stand, connecting the valve-stem to the testing tiller-rod. Put in the gyroscope-wheel, entering the forward pivot, which should not have been disturbed when dismounted, screwing in the after pivot, finger-taut, and setting up on the clamp-screws of the counterbalance center. See that it turns freely; oil bearings of the wheel.

Swing the starting-lever (on the stand) around in the direction of the hands of a watch as far as it will go. Wind up the Obry, noting that the impulse-sector meshes properly with the teeth on the gyroscope axle. Trip the impulse-spring by swinging back the starting-lever (on the stand) and note run of the wheel. If the after center, on which the counterbalance is screwed, has horizontal motion in a direction contrary to the hands of a watch, the counterbalance is too far from the center of the system, producing too great an effect, and must be screwed towards the ring; if the motion is with the hands of a watch, the counterbalance is too near the center of the system, and must be screwed out from the ring. When the counterbalance is properly adjusted, it must be secured in place by the jam-nut. If the lateral movement of the wheel cannot be corrected by moving the counterbalance in or out, the wheel itself will have to be moved in or out, as the case may be, by means of the adjustable-screw pivots through the inner rings into the cone-shaped bearings in the ends of its axis. The wheel is very sensitive to this adjustment and it must be very carefully made. After making it, see that wheel turns freely on its axis and set up the clamp-screws.

(2) *To adjust the valve:* Connect the testing-pipe with the Obry reducing-valve in the torpedo; wind up and start Obry as before; remove the centering-pin in the adjusting-arm and work the frame back and forth to get an indicator-diagram. If the diagram shows that the torpedo would deflect, due to the action of the Obry, counteract this tendency by turning the valve-plug by means of the adjusting-screws. One screw must be slackened before the other can be screwed in. The torpedo will run in the direction in which the screws are moved.

To Adjust for a Run.

15. (h) Adjust the torpedo-mechanism for a run, using the adjustment-card furnished with the torpedo:

(1) *Set the regulator.* The screw-plug, upper face, being flush with the top of the regulator-body, screw it down the number of threads indicated by the adjustment-card for the distance to be run.

(2) *Set distance-gear sector,* being careful to have cam-pin against the stud on the sector. With the zero on the sector opposite the pointer in the engine-room

door and the socket-wrench on the adjusting-spindle, set the sector at the number of teeth indicated by the adjustment-card for the distance to be run. One turn of the socket wrench gives one tooth on the distance-sector.

(3) *Set depth-index.* With socket-wrench turn the spindle until the index shows the required depth, generally from 5 to 7 feet. Set up clamp-nut, otherwise immersion-chamber will fill and, if an exercise run, the torpedo will sink at end of run.

(4) *Set vertical vanes.* Divisions to right or left shown on adjustment-card.

(5) *Lock rudder for time and position.* The rudder should remain locked until the speed of the torpedo has become somewhat uniform and the pendulum is able to exercise its normal function. It will require a distance of from 50 to 75 yards to accomplish this. One tooth on the ratchet-bar gives about 7 yards, and one division on the locking-dial gives about 9 yards. Locking for position means maintaining the rudder, up or down, or horizontal, while it is locked for time. This position of the rudder depends somewhat upon the circumstances of the dive; with a high dive or shallow water, *up* rudder may be advisable; with a low dive or deep water, *down* rudder may be necessary. Ordinarily, however, and especially for the flat dive necessitated by the Obry-gear, the rudder may be locked horizontal. Ten points on the locking-star and twelve divisions on the adjustment-cam change the rudder about one division. Both these adjustments are taken from the adjustment-card.

(6) *If for action, hook up sinking-gear or take out drain-plugs in after-body.* Removing the drain-plugs is preferable. It will be found that if one of the drain-plugs is removed from the after-body, little if any water will enter while the torpedo is at full speed, but at the end of the run sufficient water, especially with the later marks of torpedoes, will enter to sink the torpedo.

(7) (i) *Charge flask to firing pressure and replace charging-valve.* If air discharge is to be used, charge air-reservoir to required pressure.

(j) *Be careful that starting-lever is down and wind the Obry-gear.* The starting-lever must *not* be raised after this is done.

- (k) Drain after-body and immersion-chamber and replace drain-plugs.
- (l) Oil up carefully, filling oil-cups.
- (m) See that stop-valve is open.
- (n) Raise water-tripper. (Not done for war-shots.)
- (o) Try stop-pin and tripping-latch and shove torpedo home with loading-staff.
- (p) Remove propeller-lock and rudder-index; turn engines off the center; and close breech-door of the tube.
- (q) Open torpedo-port. (In time of war not to be done until within torpedo-range, and then only at order of officer in command.)
- (r) See safety-pin in place. Enter impulse-charge and primer. (The primer is never to be entered and connected until the torpedo-port is open.)
- (s) Depress the tube the number of degrees ordered, if the tube is adjustable in elevation.

GENERAL INSTRUCTIONS ABOUT TORPEDOES.

16. (1) *In time of war*, when action may possibly present itself, even though not imminent, torpedoes should be kept loaded in all the launching tubes, ready for immediate use, with war-heads attached; air-flasks charged to full working pressure. The tubes should be kept cleared away ready for instant action, and all necessary precautions should be taken to prevent premature discharge of the torpedoes. Torpedo-ports should not be opened until near torpedo-range, and they should be closed as soon as the torpedo is discharged. The spare torpedoes should be at hand (on rests, chocks, brackets, or trucks) fully prepared for use, behind armor or below water-line if possible; but it is left discretionary with commanding officers as to whether, until the spare torpedoes are actually required for use, their air-flasks shall be fully or partially charged, and whether the dry primers, exploders, and war-noses shall be placed in the war-heads.

(2) Where, as above, the air-flasks are kept charged, the pressure must be verified daily.

(3) All preparations requiring considerable time should be undertaken at the command "Clear Ship for Action!" Such general preparations should include:

- (a) Starting air-compressors and charging accumulators.
- (b) Shipping trolley-rails (where flying rails are used), or placing truck-ways at bulkhead doors (if deck-trucks are used for transporting it).
- (c) Providing the handling- and transporting-gear.
- (d) Transporting torpedoes to the tubes from which they are to be fired.
- (e) Getting up war-heads, or filling exercise-heads, and attaching them.
- (f) Charging torpedo air-flasks.
- (g) Adjusting the torpedo-mechanism and Obry steering-gear.

(4) *Torpedoes are stowed in tubes, brackets or cases, and a general rule will be for the combined crews to break out the torpedoes and transport them to vicinity of the particular tube for which intended; landing the torpedo on chocks, rests, or a truck until war- or exercise-head is attached. After a torpedo is entered in tube to charging position, each crew goes to its proper station.*

(5) *Torpedoes are transported by overhead trolleys (on standing or flying rails) or on deck-trucks, and, in exceptional cases, by hand on bearers. Propeller-locks must always be kept on torpedoes when stowed or being transported, and the transporting-screw, should be in place under like circumstances.*

TORPEDO PRACTICE.

17. (1) **The range selected for torpedo practice, under way or at anchor, should, if practicable, be free from currents, and the depth of water should not be less than five fathoms. The bottom should, preferably, be smooth and soft.**

(2) **Boats sent out to recover torpedoes should be in charge of an officer or competent man, who will keep a bright lookout to note accidents or failure to run.**

(3) *When the torpedo finishes its run the boat will go alongside to leeward, care being taken not to damage the torpedo in any way, and the man in charge will (for Whitehead Torpedo):*

- (a) Throw starting-lever forward.
 - (b) Put on propeller-lock.
 - (c) Attach the nose- and tail-lines, and the boat will then tow torpedo back to the ship.
- (4) *When alongside the ship, put on hoisting-strap, hook*

whip, previously overhauled down from deck, and pull torpedo up clear of the water. When torpedo is out of water (Whitehead) take off propeller-lock, raise water-tripper, and throw back starting-lever slightly to blow water out of engines; then turn down starting-lever and water-tripper, put on propeller-lock, and hoist the torpedo in on deck, tending nose- and tail-lines carefully to keep torpedo clear of side (a spar worked from deck makes a good fender); take final (remaining) pressure in flask; blow flask down through charging-valve or engine air-joint; lock pendulum; and strike the torpedo below to be prepared for another run or for stowage.

(5) *If torpedo is not to be used immediately*, wipe dry and give a light coat of sperm-oil or luciline, drain immersion-chamber and after-body, relieve pressure on all springs, oil all parts liable to set or rust, particularly all steel screws and the rudder connections in tail.

(6) When torpedoes are not stowed in tubes or cases, dust bags should be used to enclose tail and after-body.

(7) The recovery, etc., of a Howell torpedo, after practice, is similar to that of the Whitehead, making due allowance for difference of design and manipulation.

(8) *If for practice*, when the adjustments are nearing completion, a boat or boats should be sent out on the range to recover the torpedo at the end of its run. They should be provided with buoy, buoy-line, and sinker; propeller-lock; nose- and tail-lines and hoisting-strap. Careful observers should be stationed on deck to note run, keep track of torpedo, and make prearranged signals to the boats if necessary.

(9) *When a torpedo has made a run*, it should be critically examined and tested in all parts to see that it is fully up to its work. In no case after a bad run will the torpedo be considered to have made the service run required. The cause of failure must be at once located; and the torpedo should again be fired and the practice continued until the defect is positively known and corrected.

THE WHITEHEAD TORPEDO.

General Remarks.

18. (1) **Constant supervision** must be exercised over torpedoes to see that they are at all times protected from grit and kept clean, externally and internally; that the outer surfaces of shells are protected from rust by oil or vaseline; that the inner

surfaces of shells are protected from corrosion by a coating of red-lead paint; that all interior parts are in thorough working order and well oiled on all working surfaces; that valves and air-joints are kept free from grit and dirt and from deformation in handling; that steel screws, drain-plugs, vertical-vanes, rudder-connections, guides for rudder-connections, and other steel parts are protected by oil or vaseline from rusting; that joint-screws, stop-valves, charging-valves, drain-plugs, and external steel screws are prevented from setting, by being turned periodically; that the depth-index and regulator-springs be not given a permanent set by being kept in a state of compression for an undue length of time; that the releasing-lever spring be released from tension when not in use; and that the shell and tail be protected from injury by blows or by violent handling.

(2) **For lubrication**, use best winter-strained sperm-oil. For cleaning the shell, lard-oil with a small admixture of kerosene will be found efficient. Use fine emery cloth very sparingly, when needed, being careful not to work the shell thin; instances have recently been discovered where the constant use of emery has worn entirely through the shell in a three-year commission. Avoid getting emery grit inside. Never use emery on working parts.

(3) **In handling torpedoes**, the strain in lifting must always be applied to the thicker part, the shell of the air-flask, and never to the thinner shells of the head, or of the immersion-chamber, or of the after-body; and in handling torpedoes in the brackets, or on the trucks or chocks, the weight must be taken under the air-flask, preferably near the heads of the flask, care being taken never to let the torpedo rest on the tail for even an instant.

(4) **The tail** is the sensitive part of the torpedo. Any undue strain on the frame of the tail or on the rudder may spring these parts out of line and be destructive of accuracy. Great care must therefore be exercised, in turning the torpedo, not to use excessive force and to apply such force as may be necessary, preferably by the nose-line hooked in the exercise-nose and the tail-line hooked or hitched either to the propeller-lock or around the propeller-nuts close to the hubs.

(5) **In shoving the torpedo home** into the launching-tube, use must be made of the rammer, placed against the end of the shaft; and in hauling back out of the tube, the tail-line, hooked to the propeller-lock, must be employed.

(6) The propeller-lock is habitually to be kept shipped on the after propeller-blade and brought in contact with the forward propeller-blade whenever the torpedo is out of the tube, whether the air-flask be charged or not, and at all times prior to closing the door of the tube before launching. Instances have occurred when the air in an uncharged flask has been so expanded by rise in temperature as to give sufficient pressure to turn the propellers. The precaution of shipping the propeller-lock not only insures against injury to the person should the propellers be accidentally revolved, but furnishes a ready means for attaching and using the tail-line at any time.

(7) Torpedoes must not, except when absolutely unavoidable, be sent through the hatches with the air-flask charged. The shock of a fall might produce a serious explosion.

Care of Torpedoes after Firing Practice.

19. (1) After finishing a firing practice, if the torpedo is stowed with the intention of resuming the practice on the following day, or within a few immediate subsequent days, not exceeding one week, the following care is necessary:

(a) To blow the water out thoroughly from the engine, by allowing the engine to run slowly in the air with the water-tripper raised, until no water comes out of the shaft, being sure that the engine oil-cup contains sufficient oil to leave the engine well lubricated.

(b) To drain the immersion-chamber and after-body; to wipe dry the outside of the shell and to oil it, if stowed under cover, and protected from moisture, or to coat it with vaseline, if exposed to the weather or dampness, or if stowed in a launching tube.

(c) To dry and oil the joint-screws of the head, the engine-room door-screws, the drain-plugs, the inner surfaces of the vertical vanes, of the rudder-connections and of the guides for the rudder-connections.

(d) To release the compression of the depth-index and regulator-springs.

(e) To release the tension of the releasing-lever spring.

(f) In freezing weather the water-ballast must always be emptied from the exercise-head.

(g) A tag should always be attached to the torpedo, noting the fact that the flask contains air and stating the pressure thereof.

(2) Under all other conditions of laying the torpedo aside after firing practice, in addition to the precautions above prescribed, empty the water-ballast from the exercise-head, dry the interior of the head thoroughly and touch up with red-lead if needed; close the stop-valve, disconnect the after-body, wipe dry all accessible parts and oil working parts; touch up the inside of the shell with red-lead where necessary; open the stop-valve and let all air out of the air-flask; reassemble the torpedo, leaving air-joint screws slack to avoid making and breaking the joints too often; and remove all drain-plugs to allow circulation of air in the immersion-chamber and after-body.

(3) Air may be let out of the air-flask, on occasions when it is not desired to disconnect the after-body, by slackening up the air-joint screws connecting the air-pipe from the air-flask to the valve-group.

(4) Great care must be taken that any water which may, through negligence, be carried over by the air-charge is not allowed to collect and stand in the air-flask. To this end, while the after-body and head are disconnected, as above, if there be any air pressure in the flask, remove the charging-valve and check-valve, secure the pendulum by the transportation-screw, suspend the flask in a suitable inverted position, open the stop-valve and blow any water that may be in the flask out through the body of the charging-valve. If there should be no air pressure in the flask, remove the stop-valve, suspend the flask as before and allow any water present in the flask to drain out through the body of the charging- and stop-valves.

(5) Torpedoes stowed in launching-tubes must be carefully examined at least once each week, and especially for signs of tendency to rust at the point where the packing-band comes in contact with the shell of the torpedo.

(6) Torpedoes stowed in brackets must be inspected with sufficient frequency to detect any signs of tendency to rust and to see that they are well protected with oil or vaseline.

(7) The engines must be turned by hand at each inspection.

(8) Whether torpedoes are stowed in launching-tubes or in brackets, the reducing-valve, controlling-valve, and steering-engine valve must be examined, wiped dry and given a light coat of oil at least once in six months, if the torpedo is not in use, and at the same time the stop-valve, charging-valve, depth-index, and all exterior steel screws must be turned to keep them from setting. Propeller-locks must be kept on at all

times when torpedoes are stowed, and if stowed in brackets, the pendulums must be secured by the transportation-screws.

(9) In transporting torpedoes about the ship, and especially in sending them through hatches, the pendulums must be secured in the same manner, and the propeller-locks kept on.

(10) In preparing for firing practice, after a torpedo has remained for some time unused, care must be taken to see that all drain-plugs are replaced securely, and it is advisable to balance the rudder to see that the steering-engine works properly.

Assembling Tests.

20. While the torpedo is being assembled preparatory to practice firing, it may be given the following tests to insure that all parts of the mechanism are in proper working order and adjustment.

(1) Remove the stop-, charging- and reducing-valves and thoroughly clean and oil them. Fill all oil-cups and thoroughly oil the shaft-bearings and rudder-connections.

(2) See if the setting of the depth-index corresponds to the required pressure on the hydrostatic-piston.

(3) Examine the locking-mechanism to see if it is in working order.

(4) Sling the flask and ascertain by balancing whether it is free from water; also whether the exercise-head is full.

(5) Adjust the equalizing-springs of the pendulum to permit free movement at an inclination of $2\frac{1}{2}^{\circ}$ to 3° .

(6) Charge the flask to at least 700 lbs. pressure, and connect the air-pipe to the valve-group by the testing-pipe.

(7) See that the lock is on the propellers. Open the stop-valve half a turn and give a slight compression of about two turns to the regulator-spring. Lift the starting-lever slightly, and with a lighted taper make a thorough examination for air leaks:

- (a) At the top of the valve-group around the follower.
- (b) At the joint between the valve-group and the engine.
- (c) Around the spindle of the controlling-valve (a slight leak here is unavoidable).
- (d) At ends of valve-chests and cylinder-heads.
- (e) Around joints of air-pipes to oil-cup and steering-engine.
- (f) Around the crank-case cover and plugs in the engine-body.

(g) Around the packing in the end of the steering-engine and through the steering-engine valve.

(h) At the bulkhead joint of the air-pipe into the immersion-chamber.

(8) Remove the propeller-lock, set the distance-gear for two teeth on the sector, raise the water-tripper, throw back the starting-lever, and let the engine revolve slowly until stopped by the action of the distance-mechanism.

(9) Put on the propeller-lock. With a straight-edge on the side blade, set the rudder level and the rudder-pointer on the zero division of the scale. Raise the starting-lever and move the valve-stem of the steering-engine to and fro to see that the rudder responds freely to every movement and has full throw.

(10) Now connect the after-body to the flask and make tight the air-joint at the valve-group.

(11) Lock the rudder level for two (2) teeth on the ratchet bar, and the distance-gear for two (2) teeth on the sector, remove the propeller-lock and revolve the engine slowly to test the locking-gear. Put on propeller-lock.

(12) Try the full throw due to the steering-engine. Lay the rudder level and move the valve-stem of the steering-engine back and forth to its limit and see if the rudder-throw is at least four (4) divisions down and three and one-half ($3\frac{1}{2}$) up.

(13) Level the torpedo and balance the throw due to the hydrostatic-piston alone. The down-throw of the rudder due to *piston out* should exceed by about $\frac{1}{4}$ of a division the up-throw due to *piston in*.

(14) Test the combined effort of hydrostatic-piston and pendulum. To do this, sling the torpedo and make use of a spirit level. When the torpedo is horizontal, or when its inclination from the horizontal is less than $2\frac{1}{2}^{\circ}$ to 3° , the rudder-throw obtained should be that due to the hydrostatic-piston alone; as the inclination is increased the pendulum should cooperate to increase or lessen the throw, until finally the limit is reached. Incline the torpedo both upward and downward, and do this both with *piston out* and *piston in*. Suppose that the full throw caused by the steering-engine is 4 divisions down and $3\frac{1}{2}$ up, and that the hydrostatic-piston alone causes a down-throw of $1\frac{3}{4}$ divisions and an up-throw of $1\frac{1}{2}$ divisions. Then, swinging the torpedo as above described should give the rudder throw as follows: with *piston out*, an extreme up-throw of $3\frac{1}{2} - 1\frac{3}{4} = 1\frac{3}{4}$ divisions, and an extreme down-throw of 4

divisions; with piston in, and extreme up-throw of $3\frac{1}{2}$ divisions, and an extreme down-throw of $4 - 1\frac{1}{2} = 2\frac{1}{2}$ divisions.

(15) If the opportunity offers, the torpedo may be lowered into the water, to see if it is free from leaks in the immersion-chamber and after-body. While slightly immersed (the propeller-lock of course being on), raise the starting-lever and see if there is any excessive leak from the engine-compartment.

Miscellaneous.

21. Oiling.—This is very important, oil being both lubricant and packing. Fill all oil-cups, oil water-tripper, shaft-bearings, and rudder-connections. Oiling must never be neglected, whether for tests or actual run.

22. Air-flask.—Water should be drained from the flask only when the after-body is off, to avoid having any dirt or sediment pass through the air-pipe to the valve-group. To do this, first remove the charging- and check-valve and open the stop-valve to allow the air to escape. Then remove the stop-valve, turn the flask bottom up, and sling it so that the after-part shall incline downward at an angle of about 60° from the horizontal. After draining, thoroughly clean the valve-seats and replace the valves, then charge the flask and blow through before connecting to after-body.

23. Stop- and charging-valves.—These valves can easily be made tight by grinding in with oil, or oil and a little finely-ground glass (never use emery). Never put more than a moderate pressure on the stop-valve, as it is apt to set. After closing the stop-valve raise the starting-lever to free the air-pipe. If this air-pipe again fills, it shows that the stop-valve is not in good condition. When opening the stop-valve for a run, screw the spindle full distance up, as it is tighter in that position.

24. Hydrostatic-piston.—With the depth-index set at 5 feet, a pressure of 28.8 lbs. should move the piston. Double this pressure should correspond to a setting of 10 feet. This test is conveniently made with a push spring-balance.

25. Reducing-valve.—Must seat properly, and be well cleaned and oiled. Its plug must be tight and air-passages clear.

26. Water-tripper.—Should always be raised when the engine is turned (out of water) by air, and before actual firing (over-water discharge). It should be well oiled and must move freely. If not thrown down when the torpedo enters the water, it will

cause the torpedo to run slowly, perhaps run away, and may render its recovery very difficult.

27. (1) Faults in engine.—These may be: bearings cut, pistons broken, valve-rod bent, safety check-valve broken, crank-brasses broken, valve-rod roll-pin broken.

(2) A fault may be detected by turning propellers by hand, first observing the precaution of closing the stop-valve and blowing off. These faults are generally caused by lack of oil.

28. Faults in steering engine.—Chiefly due to wearing out of packing in gland. Air-passages may become obstructed.

29. Drain-plugs.—After every run to be taken out and then replaced. After-body drain-plug to be left out when a war-shot is to be made.

30. Propeller-lock.—Should be kept on at all times, except when the torpedo has been put into the tube for firing, or when blowing off after a run, or when testing the locking- and distance-gear.

31. (1) Rudder locked, position.—Ordinarily the rudder should be locked level. It may have to be locked slightly up or slightly down to correct diving tendency.

(2) Each turn of the steering-rod changes the position of the rudder $\frac{3}{4}$ of a division.

(3) Six points of the valve-star changes the position of the rudder one division.

(4) Ten points of the locking-star changes the position of the rudder one division.

(5) Twelve divisions of the adjustment-cam (rudder-index) changes the rudder one division.

32. Rudder locked, duration.—Shown by the record-sheet. Usually set to unlock after running from 50 to 75 yards.

33. (1) Rudder-throw.—The full throw should be about $3\frac{1}{2}$ divisions up and 4 divisions down. This throw should be obtained by hand, by the steering engine, and by the combined effort of hydrostatic piston and pendulum.

(2) When balancing the throw due to the hydrostatic piston alone, the down-throw should exceed the up-throw by about $\frac{1}{4}$ of a division—usually about $1\frac{3}{4}$ down and $1\frac{1}{2}$ up.

(3) In making these tests the lost motion due to the wearing of the rudder-pivots must be taken into consideration.

(4) When disassembling the after-body, note carefully the number of turns taken in unscrewing the steering-rod, and, in reassembling, screw it in a like number. A mistake is easily made in doing this, for the first turn or two counted may not catch

the thread. To make sure, before connecting up the after-body, that the rod permits sufficient throw, move the rudder up and down by hand and see that the pointer shows at least four divisions down and three and a half up. Then turn on air through the testing-pipe and see that the rudder responds freely to the steering-engine. It is apt to work stiffly at first, owing to the dryness of the valve. There should be no air-leak except a slight one through the steering-engine valve, and this not sufficient to blow out a lighted taper.

(5) When the after-body is connected up and the rudder does not balance correctly, it becomes necessary to determine whether the fault lies with the steering-rod or with the valve-stem adjustment. The rudder-throw due to the hydrostatic-piston effect should be about $\frac{1}{4}$ division more down than up. Suppose, however, that the mean rudder-throw due to piston-effect be one point down and at the same time the rudder will not give its full throw of $3\frac{1}{2}$ points up; it is an indication that the steering-rod is too long and should be screwed in one turn more, thus altering the position of the rudder by $\frac{3}{4}$ of a division. Generally, large corrections are made by screwing out or in to lengthen or shorten the steering-rod; refined adjustments, by lengthening or shortening the valve-stem.

(6) In making tests for balancing the rudder, considerable discretion must be used in noting the rudder-throw. Its action is more or less uncertain, owing to wearing of pivots, air-leak in steering-engine, or dryness of valve.

34. Initial dive.—This is determined by height of tube, depression of tube, length of spoon, velocity of ejection, and the position and duration of locked rudder. Assuming the height of tube, length of spoon and impulse-charge as constant, too deep diving may be corrected by lessening the tube-depression, or by locking the rudder up or for a longer time; too shallow diving, by increasing the tube-depression, or by locking the rudder down or for a shorter time. (The tube-mount must be securely clamped to prevent excessive jump.)

35. Initial dive effect on the Obry steering-device.—The short Mark III. and long Mark I. torpedoes are fitted with the Obry-gear, and they require a shallow or flat dive. Unless the dive be flat it is possible that the vessel's speed might throw the tail of the torpedo far enough forward to cause the Obry position-holder to strike the outer gimbal and make the gyroscope tumble.

36. When new torpedoes are received from the maker, special precautions are taken not to disturb the Obry-gear adjustments used on acceptance trials. It is deemed advisable, however, after receiving and assembling these torpedoes on board, to run them at least once before depending on them for a war-shot. If the Obry and all other adjustments are properly made, no deflection will be caused by the speed of the vessel. Even if the torpedo breaches after initial dive, the Obry will correct the course and give a straight run.

37. An extra guide-stud has been placed on the short Mark III. torpedoes, because the spoon of the tube is short and will not otherwise permit a flat dive. As the Mark III. torpedo when fully charged and ready for launching has a negative buoyancy of about 20 lbs., it is advisable, in making first trial-shots, to use about 1000 lbs. initial pressure for a 400 yds. run and to set the regulator for a high initial speed, in order to insure ample buoyancy at end of run. An impulse-charge of 4 oz. (or 5 oz. if the atmosphere is very damp) and a tube-depression of 2° to $3\frac{1}{2}^{\circ}$ will give satisfactory results.

38. The long Mark I. torpedo has ample buoyancy, and its tube has a spoon of such length as not to require the extra guide-stud for giving a flat dive. Its charge is 7 oz.

39. In making the adjustments preliminary to launching, do not be misled by the figures in column 6 of adjustment-card, "rudder locked + up — down." These figures refer to the adjustment-cam (rudder-index) of the locking-dial and are subject to change in handling. With the Obry installed, and the flat dive, the rudder may be safely locked horizontal.

40. Breaching after dive.—The position or the duration of locking, or both, may have to be changed. The pendulum checking-springs may be unequal. There may be an air-leak or an air-obstruction in the steering-engine. The rudder may have too much up-throw and not enough down. The reducing-valve may not work freely, owing to a burr, or dirt, or loose plug. A series of short breaches indicates that the rudder has not been unlocked, or only partly unlocked. An undulating course may be due to unequal adjustment of pendulum-springs or to obstructions in air-passages.

41. Surface run.—Generally due to leak in steering-engine. The rudder-throw may be too much up and not enough down. The steering-rod spring may be too stiff.

42. Running away.—Generally due to imperfect seating of the reducing-valve, caused by dirt or gumminess. It may be due

to the fact that the water-tripper was not thrown down on entering the water, or that the starting-lever was not pulled all the way to the rear.

43. (1) Air-leaks.—To be remedied by tightening joints or renewing washers. May be sought for by lighted taper, or best by immersing the torpedo and throwing back the starting-lever. When using lighted taper, be careful not to heat springs and so injure their temper. After setting up moderately tight with the wrench, the secret of making a tight joint lies in first loosening the screw on one side and then setting up on the side from which the air comes.

(2) Lead washers are not to be used in place of the leather washers supplied.

44. Packing-band.—Must be central, or will cause deflection to right or left. Must be tight around the torpedo, or the impulse-charge will not produce uniform result. Its tightness should be such that the force of two men on the rammer, or loading-staff, is required to push the torpedo home.

45. Stop-pin.—Before entering the torpedo into the tube the stop-pin must be down. The cocking-lever must be raised and the safety-pin put in place.

46. Tripping-latch.—Before entering the torpedo into the tube examine the tripping-latch, and after entry see that it lies fair against the starting-lever.

47. Depression of tube.—This and the speed of ejection due to the impulse-charge affect the entry of the torpedo into the water. When the axis of the tube is less than 5 feet above the water an extreme depression of 6 degrees may be given; when more than 8 feet above the water, little if any depression; when between 5 and 8 feet, a mean proportional depression. (These values are to be regarded merely as rough approximations, and must be determined for each tube.)

48. Tube-recoil.—Unless on a solid mount and securely clamped the tube will recoil and affect the torpedo's entry into the water.

49. (1) Impulse-charges.—For the small Whitehead the charge weighs 4 oz.; for the large Whitehead, 7 oz. When making up the small charge, first put 7 powder-grains of sphero-hexagonal powder in the cartridge-case and then 21 powder-grains of cubical-grain black powder of the kind used in Hotchkiss rapid-fire guns. For the large torpedo, first 12 sphero-hexagonal powder-grains and then 35 cubical black.

(2) Jam wad in end of cartridge-case and, if not to be used immediately, protect from moisture by using wax and shellac around edge of wad, and put plug in end of primer-pocket. Keep cartridges in dry place.

50. Cartridge-block.—If the bottom of the cartridge-block becomes coated with residue it will prevent the block being turned to the full locked position.

51. Firing-mechanism.—Should be tested after torpedo has been shoved home. Care should be taken to see that the friction-primer is a neat fit, with no lost motion in loop of primer, and that a straight pull is obtained; otherwise with friction-primers miss-fires are very apt to occur.

52. (1) Obry-gear.—The action of the Obry-gear upon the torpedo is to cause it to make a series of short curves, but to keep a mean straight course, varying but little from the line of sight. If the curves are long, or if the general direction taken by the torpedo is to the right or left of the line of sight, the Obry should be examined to see if it is properly adjusted.

(2) In testing or adjusting the Obry on board ship, the ship's head should remain on the same compass course, for if the ship is swinging, the change in azimuth will have the same effect upon the result as though the torpedo had deviated from its course by the same amount that the ship has swung.

53. (1) To test the Obry while in the torpedo.—See the starting-lever down, raise the water-tripper, and put the yoke on the propellers. Put the transporting-strap on, and sling the torpedo so that it may be swung in azimuth. Wind the Obry. Raise the starting-lever, which starts the gyroscope-wheel spinning by releasing the impulse-spring. Swing the tail of the torpedo gently from side to side, and note the angle, or arc, through which the tail moves when the vertical-rudders move from one side of the torpedo to the other. If the Obry is working properly the rudders should move from one side to the other when the tail is swung through an arc of one degree ($\frac{1}{2}$ degree each side of the central position); the extreme limit within which it is necessary to move the tail to work the rudders might very properly be considered as not more than 3 degrees of arc ($1\frac{1}{2}$ degrees each side of the central position). It should, however, be less than this.

(2) Continue to swing the torpedo to the right and left for four or five minutes, and notice if the limiting-points of the arc through which the tail is swung remain constant, or if it is

necessary to swing the torpedo a little farther to the right or left each time. If such is the case, and the ship is steady, then the gyroscope-wheel is probably not keeping in the same plane, as it should. It will therefore be necessary to adjust the Obry.

54. (1) **To adjust the Obry-gear.**—Take out the screws of the Obry-door and remove the door. Unscrew the holding-down screws of the Obry with a socket-wrench, and lift the Obry out of the torpedo. Put it in the frame of the adjusting-stand and screw in the holding-down screws.

(2) Swing the starting-lever (on the adjusting-stand) around in the direction of the hands of a watch as far as it will go.

(3) Wind the Obry, noting that the impulse-sector meshes properly with the teeth on the gyroscope-axle.

(4) Have a watch ready to note the duration of the time the Obry will run. (They run from ten to eleven minutes, when adjusted in the shops where made.)

(5) Trip the impulsè-spring by moving the starting-lever back in the opposite direction to the motion of the hands of a watch, seeing that it remains in the position to which moved and does not fly back.

(6) Set a pointer on the stand, close to the end of the center on which the counterbalance is screwed, so that its motion (if any) may be carefully noted. (This is the after-center on which the gyroscope-wheel turns when the Obry is in the torpedo.)

(7) If this center moves to the left (against the hands of a watch) the counterbalance is too heavy, and must be screwed towards the ring.

(8) If the after-center moves to the right the counterbalance is not exerting weight enough on the wheel, and must be screwed out.

(9) If the horizontal motion, to right or left, of the after-center cannot be overcome by moving the counterbalance in to the ring, or out to the end of the screw upon which it is screwed, then the gyroscope-wheel itself will have to be moved in the same direction. To do this, slacken the clamp-screws of both centers, unscrew one center about one-quarter of a turn, then screw the other one in carefully the same amount. The wheel will be found very sensitive to this adjustment. See that the wheel turns freely on its centers, then set up the clamp-screws.

(10) Wind up the Obry and try the running of the wheel again. Continue the operation until there is no horizontal motion of the centers of the wheel, and, of course, of the wheel itself.

(11) If the centers of the gyroscope-wheel have a vertical motion after the horizontal motion has been overcome, it probably indicates that the gyroscope-wheel is too near the ring-bearing of one of its centers, and too far away from the other one. Moving it back to the proper position would introduce a horizontal motion of its centers. The vertical motion would probably not interfere with the proper action of the Obry, however (unless the torpedo rolled), except in cases when it was so marked that the wheel had turned up to a position where the gyroscopic action was interfered with before the torpedo had finished its run.

(12) The vertical motion might be overcome by moving the wheel in the direction of its centers until in the proper position, and then filing from the heavier side of the ring.

(13) The wheel is nearer the ring-bearing of that center which has a vertical motion upwards when the wheel is running.

(14) Having adjusted the gyroscope so that the centers of the wheel do not move in azimuth while the wheel is running, make the air-connections and turn a pressure of about 150 lbs. on the steering-engine.

(15) Wind up and start the Obry, and then work the frame of the adjusting-stand back and forth to get an indicator-diagram. This will show the action of the rolling-valve of the steering-engine. Excellent cards have been taken by moving the frame through an arc of one degree (one-half degree each side of the center).

(16) If the card shows that the torpedo would have a tendency to run either to port or starboard of the line of sight (through the action of the Obry), counteract this tendency by setting the valve-plug by the adjusting-screws.

(17) One screw must be slacked up before the other can be screwed in.

(18) The torpedo will run in the direction in which the screws are moved.

55. (1) To remove the gyroscope-wheel.—The centers of the wheel may be more readily examined and kept free from rust if the wheel is kept dismounted and in the compartment provided for it in the Obry-gear box. The wheel should always be dismounted for transportation. To dismount it, come up the clamp-screws of the counterbalance-centers, but do not disturb the other center of the wheel, in order that the wheel may be put back in the same position in the ring.

(2) Jam the two nuts of the counterbalance tightly together, holding the hexagonal-headed nut with a wrench, and screwing the jam-nut tightly against it with the fingers. Then grasp both nuts with the thumb and forefinger, and by turning them to the left (and with them the center on which they are screwed) the center will screw out until clear of the axle of the gyroscope-wheel, when it may be removed.

56. (1) **Impulse-spring.**—Should the impulse-spring become weak, tauten it up as follows: Take out the screws in the impulse-sector stop, and take off the stop. Give the impulse-spring one complete turn with the winding-key, and, holding it in this position by the key, put on the stop again. Be careful to keep the fingers out of the holes through the impulse-sector, or they might be cut off by the sector in case the key should slip.

(2) Be very careful not to bend the toes of the position-holder in handling the Obry-gear. This precaution is necessary in order to insure the proper seating of the position-holder in winding up the gear.

(3) If the position-holder does not hold the gyroscope up to proper position for centering stud, the gear may be wound up so that when tripped the impulse-sector will not engage the teeth of the gyroscope; and this will cause an abnormal blow upon the stop, stop-arm and air-cushion sufficient to bend the cam-shaft and impulse-sector, thus rendering the gear useless.

Repairs.

57. The following repairs can generally be made on board ship: (1) breaks of small parts in the mechanism of the torpedo and accessories; (2) dents in the shell of the torpedo; (3) water-leaks; (4) air-leaks; (5) leaks in valves; (6) breaks or cracks in air-pipes.

58. A supply of spare parts to replace such parts of the mechanism as are most likely to be lost, or broken in exercise, is furnished with each outfit.

59. Denting the shell of the torpedo is to be carefully guarded against but, when it unavoidably occurs, the dents may be beaten out from outside the shell with a wooden mallet or copper hammer against a hard-wood block shaped to conform to the inner surface of the part under treatment. Should a steel hammer be used care must be taken not to bruise the shell.

60. Water-leaks of any consequence are unusual and may occur by reason of the drain-plugs not being screwed in tight; or, after

considerable use, by the brazing coming loose between joint-rings and the shell of the torpedo; or, rarely, by imperfect closure of the diaphragm of the hydrostatic-piston or of the rubber washers of the immersion-chamber bulkhead, engine bed-plate and tube-flange; or, still more rarely, through holes in the shell due to lack of care in preventing rust, inside or out, or caused by rough handling, or by accidental injuries incidental to service.

61. A small hole in the shell may be stopped by a steel rivet well soldered after it is clinched. A large hole, or a cluster of small holes, is best stopped by riveting over them, on the inside of the shell, a thin piece of tough sheet-steel, shaped to conform to the curve of the shell, sweating on the steel plate, soldering the rivets after they have been clinched, and soldering the holes from the outside even with the surface. The rivet-holes should, in both methods, be beveled from the outside so that the rivets may have a firm hold sufficient to resist the impulse-pressure when the torpedo is launched.

62. Use as small weight of material as possible in making repairs and be careful not to shift the ballast from its original position.

63. (1) Air-leaks may be detected, when the torpedo is in the water, by bubbles rising to the surface and, when in the open air, by hearing or by touch. If they are in parts difficult of access, they may generally be found by the employment of a lighted taper. When they are very small and difficult of location, a thin layer of oil over the part under examination will entangle the escaping bubbles and determine the exact position of the leak. This last method is particularly applicable to such parts as the exterior angles between the shell of the air-flask and its heads; the junction of the body of the charging- and stop-valves with the head of the air-flask; stop-valves of air-compressors and accumulators whose stems stand vertical; and porous castings.

(2) An air-leak in the immersion-chamber will be indicated by the distention of the diaphragm of the hydrostatic-piston. A distention of the diaphragm may be caused by expansion of air in the immersion-chamber due to rise in temperature, but this can be distinguished from the same effect produced by an air-leak by the fact that the distention will be much less, and that, the pressure being relieved by removing a drain-plug, the distention will not occur again when the drain-plug is replaced.

(3) Air-leaks in the charging-valve and stop-valve and from

the valve-group oil-cup may be neglected, provided they are very small, and a small leak around the stem of the controlling-valve, when air is admitted to the reducing-valve, is unavoidable, but all other air-leaks must be carefully attended to.

(4) Small air-leaks in porous castings can usually be remedied by compressing the metal by hammering, or by a drop of solder.

(5) Air-leaks in the exterior angle between the shell of the air-flask and its heads, at the junction of the body of the charging- and stop-valves with the head, and at the permanent joint of the air-pipe where it passes through the joint-ring of the immersion-chamber may sometimes, if very small, be stopped by solder, the surface having first been carefully cleaned. Experience has shown, however, that there is rarely any remedy for a leak around the head of the air-flask, however slight, short of a new head.

(6) Air-leaks in connections of air-pipes indicate that the nuts of the connections are not screwed down sufficiently tight; or, in connections made by air-joint screws, that the screws are either not screwed in hard enough; or that they are not set up equally on each side and are, consequently, canting the connections; or that the knife-edge of the joint, or the seat of the knife-edge, is deformed.

(7) Air-leaks around valves under which washers are used may be due to injury to the washer or to deformation of the valve. In the latter case the valve must be reground. Valves which depend for their tightness on a close fit in their seats, without the interposition of washers, must be ground in afresh when leaks are developed.

64. Before grinding valves, make sure that the leaks are not caused by the want of perfect cleanliness and, where grinding is necessary, use either oil alone, or oil and soft oil-stone, powdered and free from grit, or oil and finely-ground glass. Never use emery dust for this purpose as it is likely to become imbedded in the face of the valve, and there is danger of remaining loose particles being carried by the air into the reducing-valve and other valves.

65. Breaks and cracks in copper air-pipes are not likely to occur, but when repairs become necessary, due to this cause, cut out the damaged portion and replace it by a length of larger pipe slipped over the cut ends, letting it lap the ends at least two inches, and brazing the laps carefully with soft spelter, filing down the ends of the larger piece for a smooth finish. An air-pipe may be lengthened in a similar manner by butting against its end

the lengthening-piece, and making the junction air-tight by slipping over it a sleeve of larger pipe well brazed with soft spelter.

66. Bending pipes.—In operations involving the bending of copper air-pipes into S or other curves, the pipe must be well annealed, by being heated to a cherry-red and plunged into cold water, and then gently bent around pattern-blocks scored out around the edges to fit the diameter of the pipe, and fastened in place on the work-bench. It is customary to fill pipes with resin before bending but, by exercising due care, thoroughly annealed pipes may be bent in this manner without flattening, even when resin is not employed.

Care of Launching-Tubes and Tube-Mounts.

67. (1) Launching-tubes and tube-mounts and their fittings must be kept scrupulously clean. The interior of tubes, unpainted steel surfaces and working parts must be well oiled or, where necessary on account of wet or dampness, coated with vaseline. Water and sand must be kept clear of tubes and their mounts when washing decks, and the training- and elevating-gear must be turned daily to insure against setting.

(2) Launching-tubes and tube-mounts on uncovered decks must be protected by canvas covers, oiled or painted.

(3) After exercise with gunpowder impulse, the tube must be washed out with fresh water, wiped dry, and then oiled or coated with vaseline, and all gunpowder residue must be cleaned out of the cartridge-chamber in order that the shell of the cartridge may enter fully and permit the cartridge-block to be turned to its full locked position.

(4) Especial attention must be paid to the tripping-latch that it may always be in condition for throwing back the starting-lever on launching the torpedo.

(5) Keep the tripping-latch spring released from unnecessary compression.

Care of Air-Compressors and Accumulators.

68. (1) The care of engines of the air-compressors is governed by the rules observed in the care of steam-engines in general. Compressors should not be disassembled more often than is necessary, but with sufficient frequency to keep interior parts in a good state of preservation and in condition for working. Cup-leathers should be kept moist whenever there is a probability of the services of the air-compressor being required. An extra

set of cup-leathers should always be kept on hand, ready for emergencies.

(2) Do not exceed the working-limits of pressure assigned to compressors and accumulators, and be careful not to let water accumulate in the separator while compressing air, for, should the separator fill with water, not only would water be carried over into the accumulator and air-flask, but the separator would be in danger of bursting. Keep the blow-off cock of the separator sufficiently open, at all times while running, to just admit escape of drip-water, opening it wide only often enough to be sure that all the water is escaping.

(3) After exercise, when compressors and accumulators are not to be used for some time, drain off all water from cylinders and piping and from the accumulator, protect unpainted steel surfaces and working-parts with oil, and ease all stop-valves and drain-valves of the compressor and in the piping, to prevent them from setting in their seats.

(4) Turn over the engines of compressors daily, by hand, to insure against setting.

(5) See that there are no pockets for the accumulation of water in air- and other pipes, and take due precautions that water does not freeze in the cylinders during cold weather.

(6) Cup-leather, fiber, and metallic air-packings should be renewed when necessary, and particular attention should constantly be given to the condition of these packings to insure their successful operation.

PART V

NOTES ON ORDNANCE MATERIAL

COMPILED FROM "GUN AND TORPEDO DRILLS, 1900" AND FROM BUREAU OF ORDNANCE PUBLICATIONS.

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NOTES ON AMMUNITION USED IN THE UNITED STATES NAVY.

1. The following brief description of ammunition used in the U. S. Navy was prepared by the Bureau of Ordnance:

SMOKELESS POWDER.

2. Smokeless powder is now used for all purposes in the Navy except for saluting-charges, ignition-charges, and bursting-charges. The form now issued for all guns is a multi-perforated cylinder; for small guns, some charges consist of strips about two inches long and a half-inch wide, and some of flake smokeless powders are still in service, but are being withdrawn as rapidly as possible.

3. (1) For B. L. guns this powder is put up in cartridge-bags, and the bags enclosed in air-tight tanks.

(2) For the 13-inch and 12-inch guns the charges are in four sections, two sections being placed in each tank.

(3) For the 10-inch and 8-inch guns, 40- and 45-caliber, and 7-inch guns, the charges are put up in two sections, one section in a tank.

(4) For the 8-inch, 30- and 35-caliber, 6-inch, and 5-inch 50-caliber guns, the charges are in one section enclosed in a tank.

4. Ignition-charges.—At the base of each section an ignition-charge is secured, composed of black powder in the form of small prismatic grains, or of ordinary black rifle-powder.

5. (1) Bursting-charges.—All shell (whether common or armor-piercing) of every caliber, and all shrapnel, are loaded with a bursting-charge consisting of black, prismatic, small-grained powder, known as shell-powder. Target-practice shell do not contain bursting-charges, but the shells are brought to weight by filling them with some other material of the proper specific gravity.

(2) The following table shows the weight of the bursting-charge for shells of the various calibers:

KIND OF PROJECTILE.

Caliber.	Armor-piercing.		Common, lbs.	Shrapnel.
	Old Charge, lbs.	New Charge, lbs.		
13-inch	12.45	22.11	51.00	.....
12 "	9.4	18.18	37.75	.....
10 "	5.5	9.75	16.30	.....
8 "	3.2	5.80	8.20	.....
7 "	3.6	3.23	5.40	.....
6 "	1.3	2.00	4.00	3 $\frac{1}{4}$ -lb.
5-in. 50 lb. shell	.....	.65	2.10	1 $\frac{1}{2}$ -lb.
5-in. 60 lb. shell	.....	.90	2.50	.....
4-inch	.....	.32	1.10	1 $\frac{1}{3}$ -lb.
3-in. R. F. G.	.....	.15	.50	3 oz.
6-pdr.	.....	.....	2350 grains	.....
3-pdr.	.....	.....	900 "	.....
1-pdr.	.....	.....	180 "	.....
3-in. F'd piece	.....	.....	.35 lbs.	3 oz.

6. **Tagging-charges.**—To each bag containing a part of a charge a tag is attached stating:

- (1) The caliber of the gun for which it is intended.
- (2) The proportion of the charge that the bag contains.
- (3) The weight of the charge.
- (4) The index of the smokeless powder contained therein.
- (5) The initial velocity given by the full charge.
- (6) The amount of ignition-powder contained in the section.
- (7) The initials of the inspector in charge of the magazine.
- (8) The name of the magazine at which the powder is put up, and the date it is put up.
- (9) Attached to each tank is a tag giving the same information.

7. (1) **Marking powder-tanks.**—Each tank containing all or a part of a *full charge* is marked with a circular band, two inches wide, of white paint on the lid, with the index-number of the powder stenciled on the white ground in black letters not less than one inch high.

(2) Each tank containing all or a part of a *reduced charge* is marked with a semicircular white band, the index-number, and the letter "R" being stamped on the black ground not less than one inch high.

(3) The charge for the 6-inch, 40-caliber gun is put up in cartridge-bags, which are enclosed in a cartridge-case, each case

being enclosed in a wooden box. Tags giving the same information as that attached to the tanks for the B. L. guns are attached to the box for the 6-inch, 40-caliber gun.

FIXED-AMMUNITION.

8. (1) **Fixed-ammunition** is used for all 5-inch, 40-caliber and smaller guns.

(2) For the 3-inch, 4-inch, and 5-inch cartridges the powder is put up in bags with an ignition-charge in its base, the whole charge being placed in a cartridge-case.

(3) The projectile is forced into the mouth of the cartridge-case until its rotating band is at the edge of the case.

(4) The 1-pdr., 3-pdr., 6-pdr., and 3-inch field-gun charges are simply placed in a cartridge-case, no bag being used, the ignition-charge being in the primer. A pasteboard wad is placed over the powder, and a pasteboard distance-piece between the base of the projectile and this wad, which holds the powder in place. The projectile is forced into the case in the same manner as the larger fixed-ammunition cartridges.

9. **Boxes for fixed-ammunition.**—All fixed-ammunition is boxed.

(1) The boxes for the 4-inch and 5-inch cartridges contain one cartridge.

(2) Those for the 3-inch, 50-caliber gun, four cartridges.

(3) For the 3-inch field-gun, six cartridges.

(4) For the 6-pdr. gun, eleven.

(5) For the 3-pdr., sixteen.

(6) For the 1-pdr., sixty.

Marking Ammunition-Boxes.

10. The boxes are painted to indicate the character of the projectile.

(1) **The 5-inch, 4-inch, and 3-inch 50-caliber**, as follows:

(a) *Armor-piercing*, all black.

(b) *Forged-steel*, all lead-color.

(c) *Shrapnel*, all white.

(d) *Blind-shell*, lead-color, with ends red, and with a red band a foot wide at each end.

(2) **The 3-inch field-gun, 6-pdr., 3-pdr., and 1-pdr.** as follows:

Steel-shell, all black, white letters.

Shrapnel, all white, black letters.

Blind-shell, half red and half lead-color, upper half red,

(3) A tag giving the same information as that on the tanks is attached to the boxes, and the index-number of the smokeless powder in the charge is stenciled on each end and on at least one side.

Samples of Tags for Boxes.

11. (1) 5-inch 50-lbs. A. P. Shell.

Charge, 15.8 lbs.

Index-No. S. P., 23.

Ignition, 60 grammes fine-grain powder.

I. V. f. s.

..... Gunner in Charge.

M. L. W., Comdr., U. S. N., Inspector.

Magazine, Iona Island, N. Y.

Nov. 1, 1904. lbs.

(2) 7-inch or 8-inch B. L. R. Cal.

One-half charge, lbs.

Index-No. S. P.,

Ignition-charge, IV.... f. s.

..... Gunner in Charge.

..... Inspector.

U. S. Naval Magazine,

..... 19 lbs.

(3) 12-inch B. L. R.

One-fourth charge, lbs.

Index-No. S. P.,

Ignition-charge, IV.... f. s.

..... Gunner in Charge.

..... Inspector.

U. S. Naval Magazine,

..... 19 lbs.

12. Saluting-charges.—Boxes containing saluting-charges are painted lead-color, and are marked on top and front, with black letters. Saluting-charges are made up of black, pea-shaped, cannon-powder.

13. Drill-cartridges.—Boxes containing drill-cartridges are painted half black and half white, with white and black letters.

PROJECTILES FOR DIFFERENT CLASSES OF GUNS.

14. (1) For the 13-inch, 12-inch, 10-inch, 8-inch, and 7-inch guns forged-steel and armor-piercing shell only are provided.

(2) For the 3-inch, 50-caliber, 4-inch, 5-inch, and 6-inch guns, armor-piercing and forged-steel shell and shrapnel are in service. Shrapnel are not now being manufactured for any gun of more than 4-inches in caliber.

(3) For the 3-inch field-gun, shrapnel only are now issued.

(4) For the 6-pdr., 3-pdr., and 1-pdr. guns, steel shell only are issued.

(5) All of these shell and shrapnel are issued loaded and fused, except such forged-steel shell as are issued for target practice only, which do not contain any bursting-charge, but are brought to weight with some material having the proper specific gravity.

(6) Weight.—All shell of the same caliber are now of the same weight, the common-shell having been brought up to the weight of the capped, armor-piercing shell. Following are the weights loaded and fused:

Caliber.	Weight.	Tolerance.
13-inch	1130 lbs.	3 lbs.
12-inch	870 "	2½ "
10-inch	510 "	2 "
8-inch	260 "	1 "
7-inch	165 "	¾ "
6-inch	105 "	½ "
5-inch 50-cal.	60 "	½ "
5-inch 40-cal.	50 "	½ "
4-inch	33 "	½ "
3-inch	13 "	¼ "
3-inch field	13 "	¼ "
6-pdr.	2735 grammes.	
3-pdr.	1525 "	
1-pdr.	477 "	

Marking Shells.

15. The major-caliber projectiles are marked as follows: On the base with the place and year of manufacture, the type of shell, and its weight; on the rotating band, with the initials and stamp of the inspector of ordnance. Also on its base the serial manufacturing number of the lot.

16. The minor-caliber projectiles are stamped on the base with the name of the maker and the year of their manufacture, and on the band with the inspector's initials.

17. Blind-shell, not put up with cartridge-cases, are painted red around the point for two-thirds of the ogival, also on the

base. Blind-shell put up with cartridge-cases are painted (red) around the point only.

PRIMERS.

18. (1) For B. L. guns, both electric and percussion primers are now manufactured. The manufacture of combination primers for these guns has been discontinued.

(2) For the 6-inch R. F. gun, a combination screw-primer is manufactured.

(3) For the 4-inch and 5-inch R. F. guns, a combination drive-primer is issued.

(4) For the 3-inch 50-caliber and smaller guns, percussion-primers only are now issued.

FUSES.

19. The following fuses are being manufactured for issue to the service:

(1) For major-caliber fuses.—Merriam base-percussion, Watson base-percussion, Wilson & Chase, and Wilson and Lynch.

(2) For minor-caliber shell.—Semple base-percussion and Wilson & Chase.

(3) For shrapnel.—The Frankfort-arsenal time and percussion.

TELESCOPE SIGHT-MOUNTS.

20. Recent telescope sight-mounts, while varying greatly in details, involve the same general principles, which are:

(1) Double telescope—one for pointer and one for trainer—with either an open or a peep-sight, suitable either for day or night use, alongside the telescope, and so mounted that its line of sight is always exactly parallel to that of the telescope.

(2) The center of both vertical and lateral motion is at a point 30 to 42 inches forward of the sight-bar sword, thus minimizing as much as possible the effects of such lost motion as may exist in the mechanism.

(3) The two telescopes are mounted either:

(a) Parallel to each other on a saddle above the gun.

(b) Two entirely independent sights are fitted with a connecting-rod so that they may both be set in azimuth by one sight-setter.

(c) (in the case of somewhat older designs) Two entirely independent and unconnected mountings, fitted one on each side of the gun.

(4) Graduated scales are fitted to correct the lateral error due to speed, etc., for different ranges, the curves on the deflection scale including the error caused by drift, thus insuring the bunching of shots of the various calibers. The deflection scales of sights now building are graduated in yards, but will be changed to knots. Those now being designed are graduated in knots.

(5) The graduated scales are secured by screws which pass through elongated holes in the scales. After bore-sighting, these screws are slackened up and the scale slid along until its *zero* is opposite the index-mark on the sight; in other words, until the scale reads zero. It is then firmly secured by setting up on screws. Scales are illuminated by a small electric light.

(6) The peep-sight is mounted alongside the telescope for use either as an auxiliary sight or for night use. The front sight of some peep-sights is a cross-wire for day use, and in addition a small electric bulb for night, while in the older marks a conical front sight with small electric bulb is used both for day and night. The oldest of the modern telescope-mounts has, instead of the peep, an open V rear-sight with conical front-sight. The V is fitted with a small electric light at the bottom of the notch, for use at night.

(7) The latest holder for telescope-mounts is pentagonal in cross-section, the upper side of the pentagon being horizontal. The telescope-barrel is also pentagonal. By this means all telescopes may be adjusted in a standard mount, so that the geometrical axis and axis of collimation of all telescopes bear the same relation to each other; thus, in case of necessity, enabling one telescope to be replaced by another, without rebore-sighting, with the least possible error in the direction of the line of sight.

NOTES ON THE KRAG-JORGENSEN RIFLE.

(The caliber of this rifle is .30-inch.)

Dismounting and Assembling the Mechanism.

21. The bolt and magazine-mechanism can be dismounted without removing the stock. The latter should never be done except for making repairs, and then only by some selected and instructed men.

22. To dismount bolt-mechanism:

(1) Draw the bolt fully to the rear, then place the piece across hollow of left arm.

(2) Lift the front end of hook of extractor off bolt with left thumb, and at the same time turn bolt-handle to left with right hand. The bolt can then be drawn from the receiver.

(3) Take bolt-handle in left hand, back of hand down, bolt upside down. Grasp the cocking-piece with right hand.

(4) Slightly draw back cocking-piece and turn it towards the operator until the firing-pin can be removed from the bolt.

(5) Take firing-pin in left hand and bear down on point of striker with right thumb until it leaves the firing-pin; remove main-spring from firing-pin and the latter from sleeve.

23. To assemble bolt-mechanism:

(1) Observe that the safety-lock is turned to the left. Reverse the order of the steps of fifth operation in dismounting.

(2) Grasp the bolt-handle in left hand, as in third operation in dismounting, and the firing-pin in right hand, extractor uppermost. Insert firing-pin in bolt.

(3) Grasp handle of bolt with fingers of both hands, bolt directed downward, and with both thumbs in the rear of safety-lock, push strongly forward and turn to right with thumbs until the arm of the sleeve engages the collar of the bolt.

(4) Grasp bolt and cocking-piece as in third operation for dismounting. Draw back and turn cocking-piece from the operator until its nose enters the notch on the rear end of the bolt.

(5) Take bolt in right hand and introduce it into the receiver, keeping the extractor lifted with the right thumb. Turn bolt to right and at the same time press strongly with the first finger against right side of extractor.

24. To dismount magazine-mechanism:

(1) The gate being closed, engage the flanged head of a cartridge-case under the lug on the front end of the hinge-bar head, and turn the latter toward the gate, out of its seat; then bear heavily on the gate with the palm of the right hand, to overcome the pressure of the magazine-spring, and, with the left, press forward against the lug, drawing the hinge-bar pin from the receiver.

(2) Remove the gate, magazine-spring, carrier, and follower.

25. To assemble magazine-mechanism:

(1) Hold the piece with right side uppermost. Insert arbor of carrier into its hole in receiver and place end of left thumb across magazine to prevent carrier swinging into the latter.

(2) Place magazine-spring in its channel, convex side up, rounded end to the rear, particularly observing that the lip at its front end rests in the notch on heel of carrier.

(3) Place gate in its seat, lug entering between carrier and magazine-spring. Remove left thumb and at the same time press gate against magazine-spring with right hand.

(4) Insert hinge-bar pin in front hinge-hole in receiver with left hand, and press gate down strongly until the pin can be pushed through gate into rear hinge-hole.

(5) After the hinge-bar pin is fully home, turn the head into its seat by opening the gate.

26. To complete dismounting (to be done by an experienced man):

The bolt- and magazine-mechanism having been dismounted, proceed as follows:

(1) Remove upper-band screw and slip band forward off barrel.

(2) Loosen lower-band screw, remove band.

(3) To remove the hand-guard, raise the leaf of the rear-sight to its vertical position and move the slide to top of leaf, force hand-guard springs off barrel by screw-driver blades inserted between guard and stock, then turn guard across barrel and remove it over top of sight-leaf.

(4) Remove guard-screws and guard.

(5) Remove receiver and barrel from stock.

(6) Remove side-plate screw, then side-plate by pushing out the rear end, until free from the receiver, and drawing it to the rear.

(7) Remove ejector-pin by means of its knob, then ejector.

(8) Press trigger forward until nose of sear is withdrawn from its slot in receiver; then bearing against right side of sear, push it out of its seat.

(9) Turn cut-off until point of spring-spindle rests on ridge in spring-spindle seat of receiver. A light tap on front edge of thumb-piece will remove the cut-off. The point of the spring-spindle will rest on the ridge when the spring will not turn the cut-off up or down.

(10) To remove safety-lock, turn it vertical and strike the front face of its thumb-piece a light blow.

(11) The rear-sight leaf should never be removed from the base nor the base from the barrel, except for repairs.

(12) The barrel should never be unscrewed from the receiver.

27. To assemble after dismounting:

(1) *Safety-lock*.—Introduce the point of the tang of a small file, or any tool of similar size and shape, between the thumb-piece and the spring-spindle, thus compressing the spring and forcing the spring-spindle into the thumb-piece; insert the safety-lock spindle in its hole in the sleeve, the thumb-piece being held vertical, push the safety-lock forward, gradually withdrawing the tool.

(2) *Cut-off*.—Insert its spindle, the thumb-piece turned down into the cut-off hole in the receiver, until the spring-spindle strikes the receiver; then with the blade of a screw-driver, force the spring-spindle into its hole in the thumb-piece and push the cut-off into place. Care must be taken that the flattened and not the straight sides of the spring-spindle bear on the curved surface of the recesses in the receiver.

(3) *Sear and trigger*.—Insert the spring in its hole in the sear, start the hinge of the sear into its seat in the receiver, and with a blade of the screw-driver, compress the spring in its hole until the sear can be pushed into place.

(4) Reverse and follow in inverse order the other operations of dismounting.

COLT'S NAVY REVOLVER.

Instructions for Disassembling and Assembling.

28. (1) Turn stock-screw partly out and press on screw to loosen half-stocks and remove them.

(2) Turn out cap-screw, tap the guard and frame with screw-driver handle to loosen cap, and remove cap.

(3) Slip out hand and spring.

(4) Pass wrench handle between frame and main-spring, with neck of handle at curve of frame under swell, width of handle forward of curve, and, by twisting, wrench cam-spring down till stirrup can be thrown off. Slip main-spring out.

(5) Draw hammer off pin.

(6) With widest part of wrench-handle applied at curve of frame under swell, force down rebound-spring and slip rebound-lever off pin. Remove cylinder stop-bolt. Draw trigger off pin. With large drift, drive out rebound-spring pin and remove spring. Turn out trigger locking-lever screw and remove lever.

(7) Turn out crane lock-screw, and remove lock.

(8) Grasp crane at flat and draw it forward, thus compressing ejector-spring. Turn cylinder till any flute indexes with crane joint on frame, and remove cylinder and crane.

(9) Press latch fully back, and with small drift applied through hole in latch, push out latch-spring pin. Remove latch and spring.

(10) With large drift, drive out strut-pin, and remove strut and spring from hammer. With small drift, push out stirrup-pin.

(11) With large drift, turn off ejector-rod head, and with ejector-wrench, turn off ejector—*left-hand thread*—and remove cylinder.

(12) With crane-nut wrench, turn out crane-nut—*left-hand thread*—and remove ejector-rod and spring.

(13) The barrel will not be unscrewed from the frame, nor pins driven out, other than those before mentioned, unless to replace broken hammer-pin.

29. To assemble.—Proceed in the reverse order, except—

(1) After screwing on the ejector, until the guide-pin indexes with its hole, with the set, lightly set out the end of the rod.

(2) When replacing a broken ejector-rod, screw the ejector down the shoulder, then back off till the guide-pin indexes properly, and use the set as before.

30. (1) To assemble the latch in the frame.—Seat the latch with its spring in place. Then, with the large end of the large drift, compress the spring, pushing on the small end with the thumb of the left hand, and holding the latch in place with the forefinger of the same hand applied to the cylindrical part.

(2) With the right hand enter the latch-spring pin in the hole from the cap side of the frame, and push it home, working it over the last coil of the spring, and at the same time releasing, gradually, the pressure on the drift.

(3) It will be found most convenient to assemble the rebound-lever before the cylinder stop-bolt is entered; the rebound-lever and spring being in place and properly engaged, slip cylinder stop-bolt over its pin, and, pressing directly down on it with the large screw-driver, use small screw-driver to force point of spring down to engage on lower side of rebound-lever; as soon as the spring clears the rebound-lever, the pressure on the stop-bolt will cause it to slip home on its pin. Care should be taken not to bend the small spring more than is necessary to avoid giving it a set, and thus causing the stop-bolt to fail in its function.

(4) See that the guide-pin in cap is to rear of hand-spring before pushing cap forward to place.

(5) In assembling, place crane-lock screw-head in slot in lock and enter both together; then turn screw home. In this way the grasp of the lock on crane is insured. Be sure the crane-lock enters its slot, which will be known by heads of lock and screw coming nearly flush with frame when set up.

(6) Ejector-rod is of best Stubbs steel, untempered. It will spring some and may be set by abuse. In case rod is bent, place pistol on bench, right side down, and with cylinder turned out. Hold crane back with left hand and revolve cylinder with right, noting the throw-out of rod head. Turn rod head till the throw is up, and tap it with screw-driver handle. Revolve again to test alignment. So proceed till rod is straightened.

(7) The screw-driver handle has been designed for use as a mallet in all work about the revolver. Hold it by the neck and deliver blow with butt end. Never hold by the blade and drive with side of handle.

Hints to Armorers on Colt's Double-Action Navy Revolvers.

31. (1) Use only good sperm-oil for lubricating; if other oil be used in cleaning, see that it is carefully wiped off from all parts.

(2) The trigger locking-lever need never be removed except as it is necessary to replace a broken one; in assembling, see that the screw is set tight home.

(3) Test revolvers frequently for strength of cylinder stop-bolt spring, and replace it if stop-bolt fails to function properly.

(4) Keep the latches free from rust under the thumb-piece. It will rarely be necessary to dismount the latch to do this. Spring it fully back, clean the spot on the frame normally covered

by the thumb-piece, and oil well; then work the latch a few times.

(5) Do not dismount the crane from the cylinder unless very rusty, as unscrewing the ejector should be avoided. With the crane and cylinder dismounted from the frame, press the crane arm out of the cylinder by compressing the ejector-spring, clean and oil. Proceed in like manner with ejector-rod. If, after this, there is evidence of internal rust or dirt, it is time to turn off ejector and dismount entirely.

(6) In dismounting crane and cylinder from frame, slack, but do not turn out crane lock-screw.

(7) If double pull is heavy, examine end of crane for burrs thrown up by safety nib of trigger, when the arm has been abused.

(8) If burrs are found, remove them with smooth file. To test free working of trigger, hand, and rebound-lever, pull off at double pull; then let the trigger move forward slowly and pull back again before heel of trigger engages hammer-strut. If a rub is felt, remove cap and examine the three parts mentioned. To test free working of hammer and strength of main-spring, hold trigger back and work hammer with thumb.

(9) Keep rebound-lever clean and free from rust, especially where end of rebound-spring bears. The strain-screws are set to just bear on main-springs; if these last set by continual snapping on drill, give the strain-screws a turn. It would be well to slack off strain-screws clear of main-springs—one turn back will do it—when the arms are to be snapped much on drill.

(10) In assembling the latch in the frame, a little practice will be necessary in order to enter the pin readily. Follow the directions closely. Use the handle of the screw-driver—butt end—as a mallet in loosening cap, etc., and, in general, wherever it can be used as such. In the field, the wrench handle can be used as a hammer for the drifts.

(11) In using the wrench, as such, remember that the threads of the ejector- and crane-nut are both left-handed, and that they are light and can be readily stripped.

THREE- AND SIX-POUNDER DRIGGS-SEABURY SEMI-AUTOMATIC GUN AND MOUNTS.

Directions for Dismounting and Assembling Breech-Mechanism.

Dismounting.

32. (1) Remove the breech-plate by compressing the locking-spring and giving the lock-pin a quarter turn to either the right or left and drawing the breech-plate to the rear. Pull up the trip-plate lever to hand-firing position (this lever should always be up for hand and down for automatic firing). Unhook chain from operating-lever, by slackening turnbuckle until sufficiently loose to disengage hook from chain; then remove chain from lever.

(2) Snap firing-pin and leave it in fired position. Grasp the operating-lever handle with the left hand and rotate to the rear. At the same time, with the right hand, raise the block until it is about three-quarters of an inch above the breech-housing. By gently oscillating the lever, remove it from seat and lower block and lever from breech of gun. The extractors can now be easily removed. Unscrew shoulder-bar bolt and withdraw shoulder-bar, keeping trigger pressed against forward stop until shoulder-bar has been withdrawn sufficiently to disengage. The trigger-spring will then fall out. To remove the sear, first pull the sear-arm retaining-spring directly down with the assembling-pin. Now pull the sear-arm to fired position. Insert the end of assembling-pin in the recess in the end of the sear and pull the sear directly outward until the sear-toe hits the sear-arm. While in this position, turn the sear until the toe comes opposite the clearance-cut and withdraw.

(3) With assembling-pin press sear-spring end from its seat in the gun, when spring and arm will drop out.

(4) To remove the cocking-lever, with assembling-pin, compress the spring end of the lever-pin and withdraw it, when the lever can be taken out.

(5) Unscrew the firing-pin bushing and withdraw the firing-pin, spring and collar, using the cocking-lever to unscrew bushing.

(6) To remove or replace the firing-pin without removing block from gun: Remove breech-plate, lower the block to loading position, withdraw cocking-lever pin and lever and raise block to firing position, when firing-pin and spring can be removed.

(7) In replacing the firing-pin in the 3-pounder gun, the removal of the breech-plate is not necessary.

Assembling.

33. Place the collar and spring on firing-pin, and place them in position in block. Screw firing-pin bushing into position, place cocking-lever in position in slot, and insert cocking-lever pin, entering pin from the left side of the block. Insert operating-lever in position in block and proceed in the reverse order from dismounting.

Assembling the Mounts.

34. (1) Place the frictionless washer in the pivot-yoke seat in the cage-stand and see that the clamping-pad and screw are in position. Lower the pivot-yoke into its seat and screw pivot-bolt into pivot. Place slide in pivot-yoke and bolt down the cap-squares and clamp slide in slightly depressed position. Enter gun in slide and force it to forward position. Insert the filling-pieces in the slide, being careful to see that the screws are in their proper holes.

(2) Assemble the piston-rod and spring in the recoil-cylinder, screw in the cylinder-head and glands and fill with liquid. The glands should be screwed up tight enough thoroughly to prevent leakage and no more. Place the recoil-cylinder in position in the sleeves with the end of the piston-rod through the hole in oscillating-slide. Screw up the piston-rod nut until recoil-spring is compressed about 0.15-inch and see that the filling-hole is in the highest position possible for convenience in filling. When filling cylinder, see that air-hole plug is out.

(3) Mount the shoulder-bar and secure by shoulder-bar bolt. Place the operating-lever spring in position and adjust with turnbuckle so that the tension is sufficient to raise the block to firing position smartly.

(4) Place the trip- and spring-plate in position and screw in trip-plate bolt. Screw on the cam-plate.

(5) All screws have right-hand thread.

(6) To dismount, proceed in reverse order.

6-PDR. SEMI-AUTOMATIC GUN.—MARK II. (M.-N.).

To Dismount the Gun.

35. (1) Remove the sights (rear and front).

(2) Open the breech by the hand-lever and turn the lever down further till it assumes a vertical position, pulling back the catch; the lever can then be removed.

(3) Unscrew and take out the side-box pin and remove the side-box cover.

(4) Put on the hand-lever and compress the action-spring further, then place on the special clip which holds the spring compressed; remove hand-lever and spring.

(5) Support the breech-block and action-lever from underneath, take out the action-lever axis-pin; the mechanism is then free and can be removed.

(6) Unscrew the extractor axis-pin and remove the extractor by forcing it downwards.

(7) Unscrew the pawl-spring axis-pin and remove the pawl-spring.

(8) Unscrew the pawl axis-pin and remove the action-pawl.

(9) Unscrew the trigger-joint pin and remove the trigger-pull and spring.

(10) Unscrew the trigger axis-pin and remove the trigger.

(11) Unscrew and remove the filling-plugs and empty the recoil-cylinder, then unscrew the forward cap of the recoil-cylinder by means of the cap-wrench, and with same wrench unscrew the piston and rod so as to disconnect it from the gun.

(12) Unscrew the bolts and remove the rear cross-piece; the gun can now be drawn out to the rear, clear of the sleeve.

To Mount the Gun.

36. (1) Insert the gun in the sleeve.

(2) Replace the rear cross-piece, securing it by the two screw-bolts.

(3) Insert the piston in the recoil-cylinder from the front and, by means of the tool, screw the piston-rod into the hole in the lug on the breech of the gun, which is threaded to receive it, then screw on the forward cap of the recoil-cylinder, fill the cylinder with glycerine and water, with gun at extreme elevation, and screw in the filling-plugs.

(4) Place the extractor in position and secure it by screwing in its axis-pin, taking care that this axis-pin is screwed right home so that its head is quite clear of the sleeve.

(5) Place the trigger in position and secure it by screwing in its axis-pin.

(6) Place the trigger-pull spring in position in the pistol-grip.

(7) Replace the trigger-pull and connect it to the trigger by screwing in the joint-pin.

(8) Place the pawl in position and secure it by screwing in its axis-pin.

(9) Replace the pawl-spring and compress it by means of the hammer-handle or any other suitable tool, till the axis-pin can be screwed up against the shoulder of the spring.

(10) Take the breech-block, see that the mechanism is cocked and that the extractor-arms are back, and replace it from underneath, then pass the action-lever axis-pin through the slot in the side-box, through the action-lever, taking care that the tumbler is pointing to the rear; now lift up the pawl and the action-lever axis-pin can be pushed quite home.

(11) Push the extractor-arms forward and raise the block to the firing position by means of the handle.

(12) Take the main action-spring, compress it in a vise, and keep it in this state by means of the special clip supplied for the purpose; then replace the spring in position in the side-box.

(13) By means of the hand-lever, lower the block and compress the action-spring until the clip can be withdrawn.

(14) Again push the extractor-arms to the front and raise the block by means of the lever.

(15) Replace the side-box cover and secure it by the screw-pin.

(16) Replace the hand-lever, holding it vertically downwards, and having pulled out and disengaged the catch, turn the lever round till it is home in the horizontal position.

(17) Push the extractor-arms forward so that the lugs are clear of the recesses in the breech-block; the latter will then rise up and close the breech.

To Dismount the Mechanism.

37. (1) Release the lock-spring.

(2) Place the breech-block upside down, with the action-lever on a suitable table or bench.

(3) Drive out the split-pin, securing the action-lever pin, and remove the action-lever and pin.

(4) Pull out the trigger-lever and remove the trigger-sear with its spring.

(5) Insert the tool for removing lock-spring between the lock-spring and the rear of the block, and push it down till the rear arm of the spring is under the lugs at the end of the tool, then pull the tool smartly up and the spring will come out.

(6) Unscrew and take out the safety-sear axis-pin, then remove safety-sear and spring.

(7) Drive out the cocking-lever axis-pin and remove the cocking-lever.

(8) Drive out the firing-pin slide in the direction of the arrow, then the firing-pin can be taken out.

To Assemble the Mechanism.

38. (1) Place the block upside down on a bench, that is, in the reverse position to that which it occupies in the gun.

(2) Take the firing-pin and press it into position, taking care that the shortest opening in the slot is uppermost.

(3) Take the firing-pin slide and insert it in the block in the opposite direction to the arrow, the position of the slide being such that the word "Out" on it reads correctly when the block is standing with its top or hollow side uppermost.

(4) Take the cocking-lever and insert it in position, seeing that it is passed through the slot in the firing-pin, and replace the cocking-lever axis-pin.

(5) Push the firing-pin to the front by means of the cocking-lever, then take the lock-spring and insert it in position, with the arm having a lug on it bearing against the rear face of the block; then take the hammer with the brass part of the handle bearing against the other arm of the spring and compress the spring, at the same time pushing it down with the left hand until it snaps into position.

(6) Place the safety-sear spring on its guide-pin and replace safety-sear and axis-pin.

(7) Replace the trigger-sear with spring and secure it in position by the trigger-lever, which should be inserted with the arm at the end pointing to the front.

(8) Replace the action-lever and pin, and secure the latter with its split-pin, taking care that the action-pin passes between the safety-sear and cocking-lever.

(9) If it is required to change the firing-pin point, insert the arm of any suitable tool or spanner through the slot in the body of the firing-pin and unscrew the front part of the pin by means of the special spanner supplied for the purpose, then by means of a small pin-punch drive out the point from the rear.

THE 1-PDR. MAXIM-AUTOMATIC GUN.

(Caliber 37 m/m., or 1.457-inch.)

GENERAL INSTRUCTIONS.

To Remove the Lock.

39. (1) Take out the cover-pin, open the cover, turn the crank-handle over to the front, and see that the carrier drops; then take hold of the top of the lock-casing and raise the lock, allowing the crank-handle to come slowly back, then if there are any live cartridges in the carrier remove them (while the latter is almost fully down); now seize the lock in front, give it one-sixth of a turn either way, and lift it out.

(2) When the lock is out of the gun, and it is necessary to release the lock-spring, great care should be taken, before doing so, to see that the carrier is at the highest point.

To Replace the Lock.

40. See that the connecting-rod is upright, then holding the lock one-sixth of a turn to either side, place the rear end of the side-lever over the connecting-rod as far as it will go, turn the lock to the front and lower it into the breech-casing while moving the crank-handle forward; see that the lock-flanges are engaging in their guides in the recoil-plates, and let go the crank-handle.

To Remove Feed-Block.

41. Open the cover, and feed-block can then be lifted out by pulling it vertically upwards.

To Replace Feed-Block.

42. Open the cover, and force the feed-block downwards into position, taking care that the feed-block slide is well over to the left, so that the stud on the bottom-lever engages in the recess on the barrel-block.

To Remove the Clock-Spring Box.

43. By means of the special wrench hold the spring-box firmly, taking the weight of the spring off the securing-screw, then unscrew the securing-screw until the box can be moved and steadily turn it in a counter-clockwise direction until the spring is completely unwound; the latter can then be detached from the

hook at the end of the crank-shaft and the box can be removed. Two men are required for this.

To Replace the Clock-Spring Box.

44. Reverse the foregoing operations.

To Remove the Barrel.

45. Open the cover, and remove the lock; unwind the clock-spring so as to take the strain off the crank; remove the buffer-block, the filling-in pieces, right and left, and the muzzle stuffing-box. Insert the cleaning-rod into the barrel from the breech, remove the nut at the other end of it, and place the barrel-nut spanner over the cleaning-rod, allowing the end of the latter to pass through the hole in front portion of spanner, and push in the spanner until the projections on it engage in the corresponding notches on the barrel-nut, then replace the nut on the cleaning-rod and screw it up against the spanner; then by turning the spanner, and loosening the cleaning-rod nut, the barrel-nut is unscrewed and the barrel-spring is gradually released; the barrel together with the recoil-plates can now be drawn out to the rear.

To Replace the Barrel.

46. Reverse the foregoing operations.

N. B.—To avoid risk of injury, care should be taken not to stand in front of the muzzle when screwing up or releasing the barrel-spring.

To Remove the Ammunition-Box Bracket.

47. Catch hold of the springs at the ends of the arms, pull both away from the studs and at the same time lift the bracket with the knee until the studs are opposite the large recesses in the slots at the ends of the arms; the bracket can then be pulled off its studs and removed from the gun.

To Replace the Ammunition-Box Brackets.

48. Reverse the foregoing operations.

To Keep the Gun in Working Order.

49. (1) Before taking a gun into action, the surfaces on which all movable parts work should be thoroughly well oiled, especially the following:

- (a) Bearing parts of barrel and all recoiling-portions.
 - (b) The lock-guides on the recoil-plates, also the working parts of the lock itself, especially the levers and carrier.
 - (c) Face of feed-block and the edges of steel guides inside the feed-block.
 - (d) Bearings of the crank as far as they can be reached without stripping the gun.
- (2) In order to see that the recoiling-portion works freely, turn the crank-handle to the front until the pawls on the inside cams engage the horns of the carrier, thereby holding the lock back, then pull the crank-handle to the rear (using a lever if necessary) and by this means move the recoiling-portion backwards to see that it works correctly and can take its full travel.
- (3) Weigh the clock-spring with the spring-balance as follows : place the loop of spring-balance over knob of crank-handle and pull the balance vertically upwards ; the reading indicated when the crank-handle *commences* to move will be the weight, in lbs., of the clock-spring. This weight should be between 28 lbs. and 36 lbs., and care should be taken when weighing to see that the lock works quite freely, and that the carrier is empty. If the spring is over or not up to weight, it can be adjusted by removing the securing-screw of the spring-box as described above, and then turning the box so as either to unwind or wind up the spring ; as a rule a shift of one hole (i. e. a quarter turn) makes a difference of about 4 lbs. Turning the box clockwise increases the weight, and counter-clockwise decreases it.
- (4) Should the gun leak at the breech, remove the feed-block ; then tighten up the breech packing-gland, by means of the spanner provided for that purpose ; but if the gland is quite home and the leakage continues, it should be unscrewed, some more packing, lubricated with oil, inserted, and the gland replaced and screwed up.
- (5) Should the gun leak at the muzzle, tighten up the muzzle packing-gland, but if the leakage still continues when the gland is flush with the front edge of the stuffing-box, then the gland should be removed, fresh asbestos packing, moistened with oil, inserted in the muzzle stuffing-box and the gland replaced and tightened up. Care should however be taken that the asbestos packing does not press so tightly against the barrel as to cause it to jam ; this should be tested as described already by seeing if the recoiling portion can be moved right back when the gun is horizontal. If the packing is found to press so hard on the

barrel as to prevent this being done, the gland should be removed and some of the asbestos packing taken out.

(6) A spare lock is supplied with each gun so that if any part, such as a lock-spring, firing-pin, etc., becomes defective during the firing, the lock can be removed and replaced by the spare one.

Points to be Attended to Before Firing.

50. (1) Examine the barrel and see that the bore is clear.

(2) See that the hydraulic buffer contains the proper amount of liquid (glycerine and water in equal parts); this can be tested by putting the gun at extreme depression; then on removing the filling-plug at the rear of the cylinder, the liquid should be up to the front edge of the filling hole.

(3) See that the water-jacket is filled with water.

(4) Work the mechanism several times by means of the crank-handle, releasing the firing-pin each time, and see that all parts work smoothly and correctly.

(5) Examine the ammunition and see that it is of the proper description, that the belts are correctly filled with it, and packed carefully in the ammunition-boxes, the shells pointing towards the muzzle. To fill an ammunition-belt by hand, insert the cartridge in the loop from the thin edge, and pass it through until the front edge of the driving-band is flush with the front or thick edge of the belt. To pack a belt in the ammunition-box, place the box so that the lid can be drawn to the right, press the locking-spring and draw out the lid, then with the shells to the front lay the belt in layers in the box, taking care to fit them tightly and well up to both ends, then replace the lid. If the sight-protector is removed from the sight, see that it is screwed on to its stud on the right, outside plate.

Points to be Attended to During Firing.

51. (1) See that a sufficient supply of water is kept in the water-jacket so that the barrel shall *never* be uncovered.

(2) To load the gun, insert the ammunition-belt in the feed-block, turn the crank-handle fully to the front, pull the belt through the feed-block to the left as far as it will go, and let go the crank-handle, then turn crank-handle to the front again, pull the belt a second time, and on letting go the crank-handle the gun is loaded and all is ready for firing.

- (3) That the right hand is kept clear of the crank-handle to avoid risk of injury.
- (4) That the indicator-lever is always in the "safe" position, except while the gun is actually being fired.
- (5) That the belt is on no account to be pulled while the gun is firing.

Points to be Attended to After Firing.

52. (1) That the indicator-lever is turned to "safe," that the gun is unloaded and that no cartridges are left in the ejector tube. To unload the gun, turn the crank-handle fully to the front, let it fly back and again turn it to the front and let it go; this leaves the barrel and carrier empty; and if the lock be now drawn back till the horns of the carrier are caught by the cam pawls, then any cartridge left in the ejector tube can be withdrawn by hand.

(2) That the interior of the barrel is oiled *immediately* after firing, to prevent erosion.

(3) That the water is removed from the water-jacket, which is quickly done by removing the emptying-plug.

(4) That the lock is taken out, cleaned and oiled, and that the carrier, firing-pin, and springs are examined to see that they are not damaged.

(5) That the lock-spring is released.

N. B.—*It will not be necessary to strip the lock for this.*

(6) The gun should be covered to protect it from salt water, rain, etc.

FAILURES THAT MAY OCCUR, AND HOW TO REMEDY THEM.

53. (1) **Accidental stoppage** in the automatic action of the gun is generally due to either:

I. Inability of the lock to come back far enough to allow the carrier to drop.

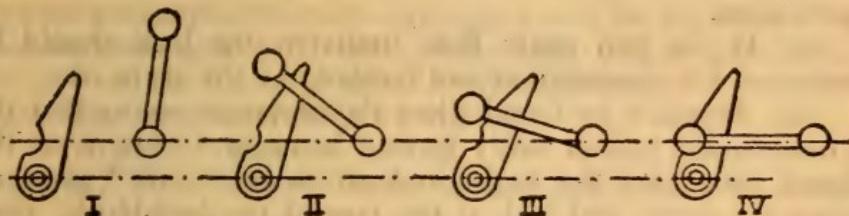
II. Inability of the lock to come right forward after recoil.

III. Carrier being unable to rise to its highest position although the lock is almost home.

IV. Failure to fire the cartridge, or to get sufficient recoil from it if ignited, although the lock has gone correctly into the forward position.

(2) In each of the above cases it is seen, therefore, that the lock and carrier are arrested in different positions, and as these are

exactly indicated by the crank-handle, the position of the latter should be carefully observed directly a stoppage occurs. To assist in doing this, diagrammatic sketches are given which show approximately the position of the crank-handle in each of the above four cases.



54. The causes of failure are probably:

- (1) Too much weight on the clock-spring, want of oil, or a light charge.
- (2) Obstruction in chamber or defective ammunition.
- (3)
 - (a) Too little weight on the clock-spring.
 - (b) Want of oil.
 - (c) Damaged lock.
 - (d) Fault of feed.
- (4)
 - (a) Miss-fire.
 - (b) Empty cartridge or one with a loose projectile.

55. The above may be remedied as follows:

- (1) There is no need to open the cover; simply bring the crank-handle fully forward and let it go, then all is ready for firing. If the stoppage is repeated the clock-spring should be lightened, as previously described, taking care to see that the indicator-lever is at "safe."
- (2) If this stoppage recurs with the spring at minimum weight, the cover should be opened and the bearings and working parts well oiled, the indicator-lever being turned to the "safe" position.
- (3) Turn the indicator-lever to "safe," open the cover, press down the carrier and turn the crank-handle over to the front, jerking it up by force if necessary, raise the lock and examine the chamber to see if there is any obstruction in it, and also the cartridges in the carrier to see if any are damaged.
- (4)
 - (a) First remove finger from trigger, then without opening the cover, strike the crank-handle sharply with the right hand to send it home, taking care to remove the hand from the knob instantly; if this is easily done and, on again pulling the trigger, the same stoppage recurs after firing a round, it will

be advisable to turn the indicator-lever to the "safe" position and to increase the weight of the clock-spring.

(b) If this stoppage recurs with the spring at maximum weight, the indicator-lever should be turned to the "safe" position, the cover opened and the bearings and working parts well oiled.

(c) If the gun again fails similarly, the lock should be removed for examination and replaced by the spare one.

(d) Should it be found when this stoppage occurs that the crank-handle cannot easily be sent home by a blow from the hand, then turn the indicator-lever to the "safe" position, open the cover, and look at the face of the feed-block, when it will probably be seen that the cartridges have not been properly fed up. Now feel the belt in the feed-block to see whether it is loose or jammed; if the former it can probably be adjusted by pulling the belt to the left front; but should it be tightly fixed with the cartridges fed crossways, withdraw the lock (taking care to press down the carrier while doing so) raise it, and clear it of cartridges; next replace the lock and fix it as follows: Turn crank-handle to the front until the cam-pawls engage the horns of the carrier, then let go the crank-handle and the lock will now be found fixed so that on pulling the crank-handle to the rear the recoiling-portion is drawn back and the top pawls in the feed-block are moved to the right, thereby releasing the pressure on the belt, so that by pulling the latter to the left front the next cartridge can usually be brought correctly into position; then close the cover, turn the crank-handle fully to the front and let it go; then on turning the crank-handle over again and pulling the belt to the left, all is ready for firing.

(e) A jam in the feed-block can usually be readily recognized without opening the cover, as in that case the recoiling-portion is prevented from going right forward, and so a space can be clearly seen between the front of the crank-bearing and the end of the slot in breech-casing.

(f) If it is found that the feed is correct but that the crank-handle cannot be sent home, then the lock should be removed for examination, and if necessary replaced by the spare one, taking care that the indicator-lever is in the "safe" position.

(g) It may be added that the plan of fixing the lock and moving the recoiling-portion by turning the crank-handle as described above, affords a ready method of oiling the bearing parts of the barrel at the most important points, viz.:

(5) (a) Just in rear of the breech packing-gland (which can be got at by removing the feed-block).

(b) At the muzzle end in front of the packing-gland.

(6) Turn the crank-handle over fully to the front, pull the belt to the left through the feed-block and let go the handle. By this action the defective cartridges will be drawn out of the chamber and placed in the ejector-tube, and a new cartridge drawn from the belt and placed in the chamber.

(7) **Miss-fires** may occur as follows:

(a) By a weak lock-spring.

(b) By a firing-pin being broken or worn flat on the point.

(c) Lock-mechanism being corroded.

(d) By a defective cartridge.

(e) In cases 1, 2, and 3, remove the lock and replace by the spare one.

(f) Case 4 is remedied as described above.

(8) If at any time a stoppage occurs during the firing, and it is desired to open the cover to examine the cause, first remove the finger from the trigger, turn the indicator-lever to "safe," and then allow two or three seconds to elapse before the cover is opened. If it is seen that the carrier is not quite up, no attempt should be made to raise it. On the contrary the carrier should first be pushed down before the crank-handle is turned over to the front to draw the lock back, as by this means all risk of firing a cartridge accidentally is avoided.

INSTRUCTIONS FOR STRIPPING AND ASSEMBLING THE GUN.

To Strip the Gun.

NOTE.—In all operations of stripping and assembling, pins are invariably driven out from the left and inserted from the right.

56. (1) Remove the ammunition-box bracket.

(2) Remove the tangent-sight and see the protector is on foresight.

(3) Take out the cover-pin.

(4) Drive out the split-pin of the cover-joint pin, remove collar and joint-pin, and take off cover.

(5) Remove feed-block, lock, and clock-spring box.

(6) Drive out the taper securing-pin (from the left) at the rear end of the breech-casing; take hold of the pistol-grip and lift slightly, strike the top edges of the outside plates alternately with a wooden mallet and the buffer-block will lift out.

(7) Drive out split-pin from the roller-nut, remove the nut, roller, and dead-stop.

(8) Pull out the filling-in pieces, right and left.

(9) Remove the muzzle stuffing-box and packing-gland, then unscrew and take out the barrel-nut by means of the special spanner (as described on page 361), remove barrel-spring, draw out the barrel from the rear, and detach it from the recoil-plates.

(10) Unscrew and remove the steam-tube.

(11) Place the water-jacket on a box or bench with the breech-casing clear of the box; drive out the water-jacket securing-pin (from the left), then give the top edges of the outside plates a few taps with a mallet (holding the weight at the same time), and taking care not to strike the gun-metal; the breech-casing will slide down the dovetails and become detached from the water-jacket.

To Assemble the Gun.

57. Reverse the foregoing operations, taking care when replacing the buffer complete to see that the groove at the end of the piston-rod is engaging properly in the recess which is cut for it in the crossbar at the rear of the recoil-plates.

To Strip the Feed-Block.

58. (1) Unscrew top-lever fixing-screw, drive out the bottom-lever and remove top-lever and slide.

(2) Drive out top-pawl axis-pin and remove the top-pawls and the top pawl-spring.

(3) Drive out bottom-pawl axis-pin and remove the bottom-pawls and bottom-pawl spring.

To Assemble the Feed-Block.

59. Reverse the foregoing operations.

To Strip the Hydraulic-Buffer.

60. (1) Unscrew and remove the buffer securing-nut at the rear of buffer-block and remove the buffer complete from the buffer-block.

(2) Unscrew and remove the buffer packing-gland and take out the packing-leather, buffer-ring, and piston.

(3) Unscrew and remove the buffer-cylinder from the outer casing or cap (if required).

To Assemble the Hydraulic-Buffer.

61. Reverse the foregoing operations, taking care when replacing the buffer complete in the gun to see that the groove at the end of the piston-rod is engaged properly in the recess which is cut for it in the crossbar at the rear of the recoil-plates.

NOTE.—It is advisable, in order to make better joints between the various parts, to smear over the threads of the screwed portions with a very thin layer of tallow before assembling them. If tallow is not available, vaseline would answer nearly as well.

To Fill the Hydraulic-Buffer when in the Gun.

62. Put the gun at extreme depression, remove the filling-plug at the rear of the cylinder and also the little screw which is on the upper surface of the outer casing of the buffer inside the breech-casing, then fill the cylinder at the filling-hole until the liquid runs out of the small hole from which the small screw was removed. Allow the liquid to overflow for a short time so that any air which has been poured in with the liquid may escape, and then replace the filling-plug and the small brass-screw.

To Strip the Lock.

63. (1) See that the lock is cocked and the carrier at its lowest position.

- (2) Drive out the pin securing the hand-sear guard.
- (3) Remove the hand-sear guard and release the lock-spring.
- (4) Drive out axis-pin for the lifting-levers and remove lifting-levers and lock-spring.
- (5) Drive out axis-pins for hand-sear and tumbler, and remove hand-sear and tumbler.
- (6) Drive out axis-pin for side-levers, and remove the side-levers and firing-pin.
- (7) Drive out the safety-sear axis-pin, and remove the safety-sear with spring.
- (8) Remove the carrier, push out gib-spring shutter, and take out gib-spring and gib.

To Assemble the Lock.

64. Reverse the foregoing operations.

Assembling Elevating-Gear.

65. (1) Block-handle is screwed in gudgeon; then place elevating-rack block in space in gudgeon, 1.252-inch x 1.15-inch, with

T-slot facing block-handle; then connect block-handle and elevating-rack block together.

(2) Place elevating-rack in gudgeon, at diam. 1.505-inch, with teeth facing elevating-rack block, then screw block-handle to the right; this will engage elevating-rack and elevating-rack block.

(3) Screw elevating cross-head on hand-wheel at 1.75-inch diameter.

(4) Place locking-ball spring in elevating-rack, at .439-inch diam., then place locking-ball on top of spring and compress both clear of diam. 1.25-inch; then screw hand-wheel on elevating-rack at 1-inch diam. The locking-ball acts as a stop.

(5) Place gudgeon in cross-head as assembled and tighten up screw in cross-head against gudgeon.

(6) Place elevating cross-head in line with holes in elevating-brackets on outside plates; then place elevating-pin through elevating-brackets and elevating cross-head at diam. .95-inch; then turn elevating-pin handle downward; by doing this the elevating-pin cannot pull out.

Disassembling the Elevating-Gear.

66. Reverse the above order.

DESCRIPTION OF MOUNTING.

67. The mounting consists of the following parts: (1) Cross-Head; (2) Elevating-Gear; (3) Pivot; (4) Stand.

Cross-Head.

68. The cross-head is a single gun-metal casting, shaped like the letter Y. The two upper branches are provided with trunnion-bearings and cap-squares, the latter being hinged to the former and held in a locked position by the trunnion-pins. The lower part or stem of the cross-head is bored out to fit over the steel pivot or adaptor, to which it can be clamped by means of a clamping-screw fixed to the upper part of the stem.

Pivot.

69. The pivot is of steel, divided into two portions by the central flange; the upper portion fits into the stem of the cross-head as mentioned before, and the lower portion is adapted to fit the socket of either the deck-stand or top-mount. In order to traverse the gun, either the clamping-screw of the mount or that of the cross-head may be loosened.

Elevating Arm.

70. The cross-head is further provided with an arm, projecting from the stem at an angle downwards, the end of this arm is forked and provides a bearing for the gudgeon.

Gudgeon.

71. The gudgeon is a short cylinder of gun-metal, carried as before stated by the forks of the elevating-arm. It lies horizontal and is capable of a slight circular movement limited by a stop-screw. Through its diameter are two holes, one round and the other rectangular, with a space cut between the two. Through the round hole slides the elevating-rack and in the other is located the elevating-rack block.

Elevating-Rack Block.

72. This block is of steel; it moves laterally in line with the axis of the gudgeon. The side towards the elevating-rack has rack teeth; in its opposite side is cut a T-groove, into which fits the flange on the screwed end of the elevating-block handle.

Elevating-Block Handle.

73. The threaded portion of this handle screws axially into the gudgeon on the right-hand side, and as its flanged end is in engagement with the elevating-rack block, the latter can be moved laterally by turning this handle.

Elevating-Rack.

74. This consists of a strong steel tube into one end of which is riveted the elevating-screw; the other end is closed. In a part of its circumference and for nearly its whole length a rack is cut, while in the opposite side is cut a square groove. This groove slides over the square end of a screw located axially in the gudgeon, on the left-hand side. The threaded end of the rack works through the axis of the hand-wheel.

Hand-Wheel.

75. The hand-wheel is made of gun-metal; its hub is prolonged on either side. The lower part fits over the plain section of the elevating-rack screw and the upper part is threaded on the inside for the screw, and on the outside for the elevating cross-head.

Hand-Wheel Locking-Device.

76. In order that the hand-wheel may not be fully unscrewed accidentally when sighting the gun, the following device is applied: The plain section of the elevating-screw has a counter-sunk hole at a right angle to its axis, a helical spring lies in this hole holding at its outer end a steel ball; this ball is constantly pressed outward and against the inner wall of the plain section of the hand-wheel. Should the hand-wheel be turned out to its extreme limit, the steel ball will be pressed half-way into a cavity located in the inner wall. This prevents the hand-wheel from being screwed further out; it can however be turned back, as the cavity is made so as to press the ball back into the elevating-screw by turning the hand-wheel the other way. To separate the hand-wheel from the elevating-rack, a hole is located over the cavity in the hand-wheel, through which a point can be inserted and the ball pushed back.

Elevating Cross-Head.

77. This is of gun-metal. The single end has an internal left-handed screw fitting over the external screw of the hand-wheel. The free ends of this cross-head fit between the elevating-rack on the gun, and the whole is secured thereto by the elevating-pin passing through the brackets and the cross-head.

Ammunition-Bracket.

78. On the right-hand side of the gun, just below and on either side of the feed-box are two studs. One is riveted to the outside plate of the gun, and the other is screwed to the water-jacket. To these studs the ends of the arc of the ammunition-bracket are attached and kept in that position by means of the ammunition-bracket.

Ammunition-Bracket Springs.

79. Springs, riveted to the ends of the arc. These springs are protected from being overdrawn by the spring-stops. The arc is further supported and kept from moving laterally by having a guide-rib of the same shape at the rear of it; this rib slides in a circular groove formed in the arc located on the stem of the cross-head. As the radii of both these arcs meet in the axis of the trunnions of the gun, these arcs are in constant sliding contact while the gun is elevated or depressed, thus forming a strong

support to the ammunition-bracket. To the downward end of the ammunition-bracket is hinged the ammunition-box holder.

Ammunition-Box Holder.

80. The ammunition-box holder lies in a horizontal position when in use, but can be turned up against the ammunition-bracket and kept there by a hook provided for that purpose, when not in use. It is a gun-metal casting in the shape of a strong arm with a cross-piece forming a tray in the center. One end of the arm is hinged to the ammunition-bracket, as mentioned before, and to the other end is fitted a spring-catch. The tray has two of its edges turned up with ribs on the inner side; these ribs fit the grooves in the gun-metal guide-strips fastened to the two longer bottom edges of the ammunition-box holder, and when engaged with the guide-ribs is pushed home, when the spring-catch, depressed by the weight of the box, raises and keeps it securely in place.

Ammunition-Box.

81. The ammunition-box is made of wood; its two longer bottom sides are fitted with the gun-metal guides, the cover-slides lengthwise in grooves; to the under side of it is fastened a brass spring-catch to keep it in place. The box is to hold two ammunition-belts of 25 rounds each.

Ammunition-Belt.

82. (1) The feeding of the cartridges into the gun is accomplished in the following manner: the cartridges are placed in the belt formed of two pieces of canvas fastened together by eyelets and brass-strips.

(2) The belt is made thick at the edge next to the bullet by being folded over so that the cartridges may lie even in the box. The canvas is water-proofed to render it insensible to climatic conditions.

COLT-AUTOMATIC GUN.**MOUNT.**

83. (1) The mount includes three parts: The saddle, the yoke, and the tripod.

(2) The saddle consists of a flat bed into which the gun fits, and an arc swinging about a pivot in the yoke.

(3) Clamp-screws are provided for securing the gun in train and elevation, while by means of a friction-screw any desired degree of freedom of motion of the arc is permitted.

(4) The tripod consists of three legs of solid, drawn, nickel-steel tubing, supporting the pivot-socket. The rear leg carries an adjustable saddle for the operator, and to it is secured a leather bag containing the following spare parts and accessories:

1 main-spring.	2 bolt-pins.
1 hammer.	2 firing-pin locks.
2 firing-pins.	1 trigger-spring.
2 firing-pin springs.	1 sear-spring.
2 shell-extractors.	1 oil-can.
2 shell-extractor springs.	2 screw-drivers.
2 shell-extractor pins.	3 drifts.
1 cartridge-extractor.	1 jointed wiping-rod.
2 handle-locks.	1 Operating-handle.

DISMOUNTING AND ASSEMBLING.

84. Under ordinary circumstances it will not be found necessary, nor is it advisable, to dismount more of the gun than the handle and the bolt; to do this the gun must first be cocked, by throwing the gas-lever back and releasing it; this cocks the hammer and enables it to be removed with the handle.

To Remove the Handle.

85. Turn backward to full extent the lever of the handle-lock on the right side of the gun in rear of the safety; then withdraw the lock, leaving the handle free to be drawn out to the rear. The handles are fitted neatly and may, when new, have to be driven out and in by light blows with a lead or wooden maul. The hammer and main-spring may be removed from the handle by releasing the sear and trigger.

To Remove Bolts.

86. (1) Throw gas-lever to its rear position and hold it there while the lever of the handle-lock is inserted in the small hole in the right side-plate just beneath the safety; by pushing this lever in as far as it will go, the bolt-pin is driven through the bolt and projects through the left side-plate, thus freeing the bolt from the slide, but locking the latter to the receiver, so that when the gas-lever is let go it cannot fly forward, being held by the slide. Withdraw handle-lock and remove bolt to rear.

(2) The extractor and firing-pin are removed from the bolt by pushing out their pins with the handle-lock, or with the drifts provided.

To Return Bolt and Handle.

87. Insert the bolt and push it forward as far as it will go, then place one hand under gas-lever, holding it against bottom-plate, and with handle-lock push bolt-pin entirely in; release gas-lever and let it go forward. Replace handle and handle-lock, turning the latter down to the locking position.

To Dismount Mechanism.

88. (1) It will rarely be necessary to dismount the gun further than as described in the foregoing paragraphs, but in case a jam occurs which cannot be cleared from the outside, or in case any inaccessible part breaks, the following general instructions should be observed:

(2) If firing has been in progress, remove belt from gun and swing gas-lever down twice to make sure of chamber being empty; remove handle as above (it will be found more convenient to remove bolt later), then lift gun out of mount and lay down on a bench, or any available clean surface, on right side.

(3) (If bolt has been removed, as above described, free slide and gas-lever by taking out bolt-pin.) Turn lock-screw of front side-plate screw until its head lies in one of the circular cuts in the head of the latter, then take out side-plate screws and remove left side-plate (the lock-screw is not removed); turn gun upright and remove right side-plate; lift frame and barrel off bottom plate and lay gun down on right side. The action of the slide and carrier may now be readily observed by swinging the gas-lever; take out pin connecting the slide with the gas-lever connection and remove the retracting-spring tubes by slipping them

off the cross-head of the retracting-connection. The slide is now free to move, being entirely separated from the gas-lever and the forward mechanism of the gun; remove trip from left side of frame, then turn gun bottom up, and, unscrewing the belt guide-screw, pry the guide out. The carrier-pin and carrier are next removed; there remain only the bolt and slide to remove (provided the bolt has not been taken out first). Push slide to rear position, and with handle-lock push out bolt-pin as before directed; then remove bolt to rear and slide can be drawn out to the front.

(4) Such parts as now remain together can, if they are to be replaced by new ones, be readily separated by removing screws and pins.

To Reassemble Mechanism.

89. (1) Proceed in inverse order, returning slide to position first, pushing it entirely back, then insert bolt and bolt-pin, then carrier and carrier-pin; put belt-guide in place, noting that the tenon on its after end fits a corresponding hole in the receiver, enter and set home screw; reseat retracting-tubes; connect slide and gas-lever connection, then put bottom plate in position; setting gun on bottom-plate, return right side-plate to position, *being careful to see that feed-lever lies between the two lugs on the slide*, and that head of connecting-pin lies in groove in side-plate.

(2) Return trip to seat, then put on left side-plate and screw down. Return handle and handle-lock.

To Replace Trigger or Sear.

90. Push out pin, using handle-lock as drift; in putting in new sear or trigger or new springs, be careful to see that the springs are properly seated. The same caution must be observed in replacing an extractor, and in this case the pin must be entered so as not to project at either end.

CARE AND MANAGEMENT.

91. (1) The rate of fire of the guns as now issued to the service is fixed at a minimum of 400 shots per minute, and each gun is required to maintain this rate for one minute without stoppage, before being accepted from the manufacturers.

(2) The rate of fire depends on several points in the construction of the gun.

First.—It is obvious, since the energy required for the operation of the gun is derived from the pressure of the gases escaping through the gas-vent, that the interval between shots cannot be less than the time consumed between the explosion of a cartridge and the passage of the bullet over the vent; this, of course, depends in the main on the initial velocity of the bullet, and can be regulated by changing the powder charge.

Second.—The second condition governing the rate of fire is the location of the vent in the bore in a longitudinal sense; this affects the rate of fire in two ways: First, by the time consumed by the bullet traversing the bore to the vent; and, second, by the amount of pressure obtained through the vent.

Third.—The third governing condition is the size of the vent, which regulates the amount of gas taken from the barrel and consequently the available force for operating the gun.

Fourth.—The weight of the moving parts is an element affecting the speed, the gas-lever itself being the most important. Small changes in the weight of this part effect considerable alterations in the rate of fire.

Fifth.—And dependent on the second and fourth, the length of the various levers and connecting-rods, and the consequent time consumed in completing one motion, affect the rate of fire.

Sixth.—The rate of fire may be altered by changing the point of firing. The gun, as has been before explained, is fired when the trip, operated by the slide, releases the sear from the hammer; the point in the motion of the slide at which this takes place can be altered by changing the length or location of the cut which operates the trip; as at present made, the gun fires when the gas-lever is about $1\frac{3}{8}$ inches open; if it were so arranged as to fire with the lever entirely up, it is evident that more gas pressure would be utilized and the speed would be correspondingly increased; conversely the speed may be reduced by causing the gun to fire with the lever more open. The limits of variation due to an adjustment of the firing instant are, of course, narrow, as the bolt must be fully closed and locked before firing.

Seventh.—The point of firing can be slightly delayed by flattening the lower side of the trip-pin which operates on the sear; this will allow the lever to close further before the hammer is released, and the rate of fire will be slightly increased.

(3) It will be noted that the operations of the various parts of the gun are so timed that, if they perform their work properly and the ammunition is good, no jams can be caused (the personal

equation of the operator being eliminated by the automatic action), the gun cannot be fired until the bolt is fully closed and locked; no other operations can begin until the gun has been fired and the bullet has passed the vent; the next cartridge cannot be fed up until the fired case has been extracted and ejected. Jams can, then, occur only as the result of the failure or breakage of some part.

(4) A jam or breakage of any kind causes an instant stoppage of the gun, and immediate examination should be made to ascertain and remove, if possible, the cause.

92. The following accidents have occurred in experimental firing and may occur again, though the causes, so far as they have been discoverable, have been removed:

(1) **Hang-fires.**—These are due to the slow ignition of the powder, and may be expected to be eliminated when increased experience with these powders enables the manufacturers to produce primers which will make ignition as sure and as rapid as with black powder. Ordinarily the hang-fire is of only just perceptible duration and will scarcely attract attention; they have been known, however, to last several seconds, and they then become dangerous; the automatic gun will, of course, wait for the explosion, and if the operator will do the same, there is no trouble to be apprehended.

(2) **Miss-fires.**—These will not be frequent in good ammunition, but may sometimes occur and, of course, stop the action of the gun.

(3) **Incomplete action of gun, causing bolt to close on empty case.**—This results from firing a cartridge with a reduced powder charge, and will be a very rare accident. The effect is to throw the gas-lever partly down, and then to allow it to close again without ejecting the fired case, which may either be returned to the chamber by the closing-bolt or may be jammed in the receiver, due to partial ejection, in which case the lever will not be entirely closed.

93. (1) These three accidents have the common feature of stopping the gun with the gas-lever up, while in others, to be mentioned, the lever is left in some intermediate position. Consequently this general rule must be observed:

(2) *Whenever the gun stops firing in the midst of a belt, keep the finger on the trigger and look at the gas-lever.* If this is entirely up, maintain the trigger pressure for two or three seconds, in which time, if the stoppage was due to a hang-fire,

the gun will be discharged and the firing will be resumed. In case the gun does not fire, the difficulty is probably attributable to the second cause, a miss-fire, and the trigger should be released and the lever operated once by hand. Upon then pulling the trigger, the firing will recommence.

(3) A cartridge should never be allowed to remain in the chamber longer than six or seven seconds, as, with the gun hot from rapid firing, the cartridge may be discharged by the heat.

(4) The method of handling a miss-fire serves also for the third accident mentioned above.

94. In case the gun stops with the lever open, one of the following conditions may have arisen:

(1) **"Following up" of sear.—**

(a) This is due, in a new gun, to too great thickness of the nib of the sear, so that the bolt does not push the hammer back sufficiently far for the sear to engage it; this difficulty is usually evidenced by a faint impression of the firing-pin on the primer. To remedy it, release and draw out the feed-belt and empty the chamber of the gun by operating the lever by hand twice. Then remove the handle from gun, take out sear and replace it, or, if the same one is to be used, file the inner face of the nib slightly with a flat file. A very slight reduction in thickness of the nib will remedy the defect.

(b) The same effect, of "following up," may be caused by wear of the notch around the head of the hammer; the remedy for this is, obviously, to turn the hammer and present a new portion of its circumference to the sear.

(2) **Non-extraction or non-ejection.—**

(a) This will be shown by the presence of an empty case in the receiver, partially drawn out or partially ejected, or by a new cartridge jammed over the empty case in the chamber.

(b) This accident is generally due to a broken extractor, or it may be due to the third of the causes above enumerated, the energy of the discharge being insufficient to bring the empty case into contact with the ejector.

(c) The remedy is to clear the jam, remove the empty case, and to examine the extractor. If it is broken or chipped on the nib, or if the spring fails to work well, replace it.

(3) **Jam of cartridge in carrier.—**This accident has been of rare occurrence, and it is not at present possible to say with certainty what causes it, but it is probably due to faulty action of the carrier-dog and spring. The cartridge is, in this case, engaged

by the bolt and pushed forward before it has been raised to the correct loading position, and is thus jammed between the two sides of the carrier. To clear it, *do not attempt to push it forward or to cant it*, but work the mechanism gently a few times, without allowing the bolt to touch the cartridge; this will loosen the cartridge and allow it to be removed.

(4) **Jam in feed.**—This may be due to uneven loading of belts, or to a cartridge fitting too tightly into its pocket, so that the cartridge-extractor cannot draw it out. It can be cleared through the hole in the right side-plate.

(5) In general, when a jam or stoppage occurs, due to any cause, the first thing to do, after waiting long enough to see that it is not a hang-fire, is to release the trigger, then to work the gas-lever gently by hand, observing the mechanism meanwhile to see what the cause of the stop is. Jammed cases or cartridges may be removed through the ejection-opening with the blade of a knife or the point of a screw-driver.

95. A wooden operating-handle is provided, among the accessories, which may be slipped over the gas-lever pin, for operating the lever when the gun is hot.

96. **The only cautions that need be observed** are these:

(1) If the gun stops with the lever closed, wait two or three seconds to see if a hang-fire has occurred.

(2) If the gun is very hot, as after continuous firing for three or four minutes, release the belt and draw it out an inch or two to the left, then work the gas-lever, emptying the chamber.

(3) Always, in operating the lever by hand, do so slowly, observing the action of the mechanism meanwhile, and do not attempt to clear any jams by force.

(4) In loading belts, see that the cartridges are all pushed well home in the loops, and that their bases are perfectly even; if possible, lining them up with a straight-edge.

THE BELT LOADING-MACHINE.

97. This machine is furnished to facilitate the rapid charging of the canvas belt with cartridges. It should always be used in preference to hand-loading on account of both its superior speed and superior accuracy of loading. Before beginning to use the machine, see that it is well oiled and that the needles are properly set.

98. A detailed description of it will be found in Bureau of Ordnance pamphlet, entitled "Colt-Automatic Gun, Caliber .30, Sep-

tember, 1902." A repetition of this description at this place is unnecessary, as the functions of the mechanism are easily understood by observing the machine in operation.

99. (1) **To fill a belt with cartridges.**—Fasten the machine to a table or bench, and turn the crank to the right until it is straight down. Release the tension-spring hook, and raise the upper feed-wheel as far as it will go. Turn the belt-guide cover to the right far enough to admit the belt into the belt-guide, and raise the upper needle-bar as far as it will go. Put two cartridges by hand into the two loops of the belt nearest the end with the brass tip, and place the belt in the machine with the first cartridge resting in the top groove of the lower feed-wheel, and the belt passing out at the back through the belt-guide. Return the belt-guide cover to place over the belt (being careful to see that the belt is free to pass under it), and lower the needle-bar. Turn the upper feed-wheel down upon the belt and secure the tension-spring under the hook. Fill the feed-guide with cartridges by stripping ten at a time from the paper boxes in which they are packed. Turn the crank to the right and the cartridges will be fed into the belt ready for use in the gun.

(2) Place a feed-box ready to receive the filled belt and at such a height that not more than 2 feet of filled belt will be suspended from the feed-wheels of the machine. In case of a miss in charging the belt, stop and open up the machine and remove the belt. Turn the crank to the right until straight down, as in starting, and replace belt in machine with the next to the last cartridge in the top groove of the lower feed-wheel. Close the machine and proceed as before. A miss may be caused by broken or imperfect adjustment of the needles.

MISCELLANEOUS INSTRUCTIONS.

LIQUID FOR RECOIL-CYLINDERS.

100. (1) The mixture used in the recoil-cylinders consists of glycerine, 80 parts by measure, and water, 20 parts by measure. The glycerine used should be free from fatty acids, and the following tests are prescribed:

(2) Add to a sample of the glycerine in a large test-tube about an equal bulk of a saturated solution of slackened lime and thoroughly shake the two together. If, after standing some time, a sediment is deposited the glycerine contains fatty acid, and is unfit for use in recoil-cylinders.

(3) Take another sample of the glycerine in a test-tube and add about an equal bulk of a saturated solution of acetate of lead. If, after thoroughly mixing and standing for some minutes, a deposit appears, add acetic acid and heat the contents of the tube. If the deposit disappears, or if no deposit appears after the mixing with the acetate of lead, the glycerine is free from fatty acid and fit for use in the recoil-cylinders.

(4) Both tests should be made, as one is the confirmation of the other.

(5) The liquid in the recoil-cylinders (glycerine 80 per centum, fresh water 20 per centum) becomes muddy after a time; and the grooves of the cylinders may become clogged from a deposit of a thick, pasty sediment which is removed with considerable difficulty. It is therefore directed that the recoil-cylinders be emptied, cleaned and refilled directly after the vessel is commissioned, and at the end of each year thereafter; as much fresh liquid being added from time to time as may be necessary.

(6) The circulating-pipe, on carriages having two recoil-cylinders, must be carefully looked after, to guard against clogging, and be thoroughly cleaned whenever the cylinders are emptied. Blow through the filling-holes to see if the circulating pipe is clear.

(7) As recoil-cylinders occasionally leak, even when they seem quite tight, especial attention will be directed to them during the daily inspection, in order to ascertain whether there is any perceptible leak. Loss of liquid therefrom will be supplied at once. Before every firing, unless an emergency makes this impracticable, the recoil-cylinders shall be invariably examined and filled.

INSTRUCTIONS FOR FILLING RECOIL-CYLINDERS OF 4-INCH, 5-INCH, AND 6-INCH MOUNTS.

101. (1) The gun being out to battery, lay it with the breech very slightly elevated. Remove plugs of filling- and air-holes. Place funnel, and pour liquid in slowly until it runs out of air-hole. The cylinder of the 4-inch mount holds $32\frac{1}{2}$ pints; that of the 5-inch holds 2 gallons; and that of the 6-inch holds 4 gallons.

(2) If there is no air-hole, care must be taken to pour the liquid into the funnel in small quantities. Care also must be taken to measure the quantity of liquid poured into the cylinder.

INSTRUCTION FOR FILLING CYLINDERS OF 6-PDR., 3-PDR., AND 1-PDR. HYDRAULIC-RECOIL MOUNTS.

102. All hydraulic-recoil mounts for minor caliber R. F. guns thus far issued to the service, except the Mark III. 6-pdr., have only one filling hole in the boss on the cylinder. The funnel is placed in this hole, and in all other respects the process of filling the cylinder with liquid is the same as that described below for the Mark III. 6-pdr. mount.

MARK III., 6-PDR. HYDRAULIC-RECOIL MOUNTS.

103. (1) In mounts fitted with the Driggs-Schroeder gun, the shoulder-bar must first be unshipped.

(2) Elevate the breech as far as possible and lock in that position. Take out the top screw in filling-hole boss and unscrew the side one until only about three threads remain engaged. This opens a free passage into the cylinder by way of the top hole, into which now screw the filling-funnel. Take off the cylinder-head. Pour the liquid into the funnel until its level in the cylinder rises to the lower front edge of the thread for the head, until it appears in rear of the piston. About $3\frac{1}{2}$ pints of liquid have now been poured into the cylinder. Screw in the cylinder-head, hand taut, and level the mount. Fill the funnel. Increase the air-space in the cylinder by unscrewing the cylinder-head four or five turns. The funnel will empty itself. Screw up the head, refill the funnel and proceed as before until no more liquid will run out of the funnel when the cylinder-head is partly unscrewed. The cylinder is then sufficiently full. This is made evident by the rise or fall of the liquid in the funnel when the head is screwed up or unscrewed a turn or two.

(3) Now set up the cylinder-head for a full due, hard against the leather packing, using the wrench. Screw the side-screw firmly into its seat, remove the funnel, and put in the top-screw.

(4) The 6-pdr. cylinder holds, when full, $4\frac{1}{2}$ pints of liquid.

(5) The whole operation can readily be performed in five minutes.

REPLACING PISTON-ROD PACKING.

104. (1) To set up or replace the piston-rod packing at front end of recoil cylinders of minor caliber R. F. guns, the gun being mounted, depress the breech and lock securely in position.

(2) Take off the two piston-rod nuts on outside of oscillat-

ing-slide, and ease gun into position of full recoil. This will give plenty of room to get at the stuffing-box gland.

(3) When the gun is again run out, care must be taken to see that the piston-rod nuts are fully set up. The shoulder inside of threaded part of piston-rod (where the rod increases in diameter) must be drawn close against the inner face of the oscillating-slide so that the clearance between the rear face of the piston and front face of the cylinder-head shall be preserved. This clearance is from .10-inch to .15-inch, depending upon the thickness of the leather packing on face of cylinder-head.

CARE AND PRESERVATION OF CARTRIDGE-CASES.

105. To prevent the rapid deterioration of metallic cartridge-cases, the following rules must be observed for their care and preservation:

(1) The cases at all times, whether before or after firing, should be kept free from salt moisture, oil, or grease of any kind, and from time to time, as opportunity occurs, they should be examined, especially at the neck and mouth, for signs of corrosion.

(2) The hot cases, when withdrawn from the gun after firing, should not be allowed to fall to the deck, but should be caught with gloved hands, or in the case of the smaller calibers, in an apron. The larger cases when empty should not be laid on their sides, except unavoidably, but should be stood up on end or replaced in their boxes.

(3) As soon as possible after firing, the fired primers should be backed out; and the cases thoroughly cleaned with hot water and soap suds. In the larger cases, a primer-pocket is used, and this must be backed out by means of an iron or brass rod, the case standing on a block of wood with a hole in it. These pockets should be cleaned and dried, the caps being first backed out of the percussion ones, and should be turned in with the empty cases for reloading.

(4) Should it be intended to clean the cases immediately after firing, dipping them into water, mouth down, while still hot, will be found to assist in the subsequent removal of the powder residue. Should it, however, be impracticable to clean the cases for a day or more after the firing, they should be stowed away perfectly dry for the interval.

(5) If the residuum is found difficult of removal, a little lye may be added to the water used in cleaning, but hot soap suds

will usually suffice, the soap being not used in lumps. After cleaning, the cases should be rinsed with clean water, drained, thoroughly dried, inside and out, and put away in their boxes.

(6) No oil or grease of any kind should ever be used on the cases, except in the operation of reforming, when they may be lubricated either with a mixture of lard- (or sperm-) oil and plumbago ($\frac{1}{4}$ pound plumbago to 1 gallon oil), or with white-lead and tallow (3 parts white-lead to 1 part tallow), in either case only a very thin coating being applied, and the cases being carefully wiped clean when reformed.

REFORMING- AND RELOADING-TOOLS.

Description.

106. The following is a description of reforming- and reloading-tools for minor caliber R. F. guns:

(1) **Dies.**—Steel, cylindrical in form, of 4-inch outside diameter, 17.5-inch length, and bored to dimensions slightly less than the cases they are to reform. A number of small holes (air-vents) are drilled through at various parts of their length to prevent dishing the case, and each die is fitted with a bronze handle placed over its center of gravity.

(2) **Ejectors.**—Steel, turned from a single piece, and of dimensions to go in the mouth of the corresponding case.

(3) **Decapping-tool.**—A cylindrical-steel rod 0.5-inch in diameter, 11.6-inch long, terminating in conical point rounded on end.

(4) **The cap-follower.**—A steel disc of 4-inch diameter, counterbored at its center to avoid compressing the primer-cap, and with cylindrical handle projecting from its rear face.

(5) **Reloading-blocks.**—Hollow, bronze cylinders, countersunk on the end to fit the heads of the different cartridges and bored through to avoid contact with primer.

(6) **Centering-block (point).**—A bronze-cylindrical disc, bored at the center with an ogival-shaped countersink, and having on its rear face a hemispherical boss 1-inch in diameter.

(7) **Centering-blocks (body).**—Bronze half-cylinders, bored out to 1.834-inch and 2.224-inch respectively, for centering the 3- and 6-pounder shell in reloading.

(8) **The bed.**—A bronze casting, semi-cylindrical in section, cast with flanges to secure it to a bench, ribs to stiffen it, and lugs at each end to take the thrust. A slot is cut through the bottom of the bed. The inner lug is finished on both faces and bored through in the axis of the semi-cylinder to receive a

flanged nut, which rests on a frictionless washer placed between the flange and the lug-face. The nut is fitted with a lever on its inner end and is tapped to take a screw with a rectangular thread. This screw has a face-plate in one with it. The face-plate has a lug on its lower side which passes through the slot in the bed and is prevented from rising by a nut which is screwed on from below. A hinged clamp, bored out to 4-inch diameter and with a slot cut on the inside to take the rib on the centering-washers, is fitted to the bed.

(9) **Centering-washers.**—Steel rings, bored to fit the neck of each caliber and class of cartridge and cut in halves. They have a rib on the outer circumference which fits in the slot-way of the clamp and bed.

Directions for Use.

107. (1) See that the cartridge-cases are clean, free from grease and verdigris inside and out, and that the primers have been backed out with the decapping-tool.

(2) Wipe out the inside of the die.

(3) Lubricate the case thoroughly with a mixture of 3 parts of white-lead to 1 part of tallow, spreading it evenly with the hand and removing any grit encountered (either a mixture of $\frac{1}{4}$ pound plumbago to 1 gallon of lard- or sperm-oil, or strained soft soap may be used).

(4) Run the screw out as far as possible, open the clamp, put in the die, fasten clamp.

(5) Insert the cartridge and screw home, taking at least 45 seconds.

(6) Withdraw screw, insert primer squarely, place the cap-follower against it and screw home. Slack screw and remove cap-follower.

(7) Insert ejector from the rear, unclamp, turn the die end for end, screw up, and force cartridge-case out to rear.

(8) Pour powder charge into case, a little at a time, and shaking it well down; place a wad over the charge; remove die and put in loading-block and lower half of centering-ring belonging to the caliber.

(9) Place cartridge in position with base against loading-block and neck on centering-ring; put in upper half of centering-ring and fasten clamp. Run screw out.

(10) Put in "point centering-block," being careful that it rests squarely against the face-plate. (If for a 3- or 6-pounder also place the body centering-block.) Place nose of shell in centering-

block and base in cartridge-case. Then screw slowly home, until the rear edge of band just reaches lip of case.

(11) Remove completed cartridge.

(12) In reloading ammunition for rapid-fire guns of all calibers, the rim of each cartridge-case shall be nicked on the edge with a file so that the number of marks on a case shall indicate the number of times it has been fired.

(13) Whenever reloaded cases are packed in boxes the place and date of the last loading shall be noted on the label.

BRONZING STEEL GUNS.

108. (1) The gun must be thoroughly clean and free from all oil and grease. Scrape all parts as clean as possible and brighten all parts to be bronzed, first using coarse emery cloth, and finish with fine. After the gun is brightened, it is washed off with a strong solution of lye, about $\frac{1}{2}$ lb. to a gallon of water, after which the lye is washed off with fresh water. This cuts all grease or dirt that remains on the gun and leaves a chemically clean surface for the bronzing-mixture. Great care must be taken to keep the bare hands from touching the gun after it is clean and bright, as oil from the hands will spoil the clean surface and prevent a good molecular contact of the bronzing-mixture. The gun, after being cleaned in this manner, is ready for the bronzing-mixture, which should be applied with a fine marine-sponge.

(2) Either of the following mixtures may be used, viz.:

Mixture No. 1.

2 oz. Spirits of wine.
2 oz. Tincture of steel.
 $\frac{1}{2}$ oz. Muriate of mercury.
 $\frac{1}{4}$ oz. Copper-sulphate.
1 pt. Hot water.

Mixture No. 2.

1 oz. Copper-sulphate.
1 oz. Sweet spirits of nitre.
 $\frac{1}{8}$ oz. Tincture of steel.

(3) After being applied, the mixture should be allowed to dry from 10 to 12 hours. After drying, the mixture is washed off with boiling fresh water, and the gun allowed to dry; when dry the gun is ready for the lacquer.

Lacquer No. 1.

1 gal. Mineral sperm-oil.
 1 gal. Linseed-oil.
 $\frac{1}{2}$ lb. Beeswax.
 $\frac{1}{2}$ lb. Rosin.
 $\frac{1}{2}$ pt. Driers.

Ivory-black may be added to suit taste.

Lacquer No. 2.

1 pt. Linseed-oil.
 1 qt. Crude petroleum.
 $\frac{1}{8}$ pt. Driers.
 $\frac{1}{4}$ oz. Camphor.
 1 pt. Alcohol.

(4) Lacquer No. 1 makes a very good body or first coat, and should be applied daily until the desired body is obtained. Great care must be taken to put it on as thin as possible, and to rub it dry with the bare hand. After a good body has been obtained, the gun can be kept in good order with lacquer No. 2, which is a polishing lacquer, with less body.

(5) Dry weather should always be selected for bronzing, as the guns must be kept dry from the time they are bronzed until they have a fair body, and no gun will have a good gloss unless the lacquer is well rubbed in with the palm of the hand.

109. Another method is as follows:

(1) Cleanse the parts to be bronzed with potash to remove all grease, and wash off with fresh water. When dry apply the following solution:

One-half an ounce of sweet spirits of nitre.
 One-half an ounce of powder of blue vitriol.
 One-half a pint of fresh water.
 Mix until dissolved.

(2) Rub the mixture well over all parts to be bronzed; let it remain about twelve hours and, if necessary, touch up bare spots. When completely bronzed, wash off with fresh water.

(3) When the gun is dry, apply the following mixture until a good coat is produced, rubbing each coat in well with the bare hand:

One-half a pint of linseed-oil.
 One ounce of powdered rosin.
 One ounce of beeswax, cut small.

- (4) Boil together until dissolved, then strain; rub in dry from two to three coats.
- (5) When the gun has obtained a good coat, rub up with clean rags and a little mineral sperm-oil, to polish.
- (6) Material required for six 6-inch rifles:

Twelve ounces sweet spirits nitre.

Twelve ounces powdered blue vitriol.

One gallon linseed-oil.

One pound beeswax.

One gallon mineral sperm.

PART VI

PHYSICAL EXERCISES

ORDER OF SUBJECTS

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SWORD EXERCISE.

NOTE.—This sword exercise was originally prepared by Prof. A. J. Corbesier, Sword Master at the Naval Academy, assisted by Lieut. W. F. Fullam, U. S. N.

It is inserted in this book purely as a physical exercise, to be carried out as such at the discretion of the Commanding Officer, or to serve as a guide to officers or men who desire to perfect themselves in the use of the sword as a weapon. It is not intended that time be spent in carrying out Sword Exercise as a regular routine drill.

GENERAL REMARKS.

1. (1) In this exercise attacks are made by thrusting with the point of the sword, or by cutting with the edge. The attack with the point is usually more deadly, and there is less exposure to counter attack than there is in making the slashing blows that alone render the edge effective; both methods may, however, be used; circumstances must determine.

(2) For instruction, the men form in one or two ranks facing to the front, swords at the *order*; intervals and distances are taken as in the drill regulations; swords are brought to the *carry* at the preparatory command for marching, and are brought to the *order* on halting.

(3) In the exercise, the sword is held in the right hand, thumb along the back of the gripe and almost touching the guard, the fingers united underneath, holding the hilt rather loosely.

(4) Movements that may be executed in the same general manner toward either flank, are explained as toward but one flank, it being necessary to substitute the word *left* for *right*, or the reverse, to have the commands and explanation for the corresponding movement toward the other flank.

THE MOULINETS.

1. *Sword exercise, 2. MOULINET.*

2. At the first command, raise the sword to the height of the right shoulder, edge to the right, back of the hand up, arm extended to the front; at the same time make a half face to the left, the right toe square to the front, feet at right angles, heels together, and carry the left hand to the small of the back, body erect, eyes to the front. At the second command, drop the point to the left and describe a full circle without bending the arm, the sword grazing the left shoulder, opening the fingers to give

play to the hilt, and resume the original position; then reverse the hand, finger nails up, edge to the left, and execute a moulinet to the right of the body in a similar manner, continuing the moulinets alternately. At the command: 1. *Order*, 2. SWORDS, resume the *order*.



Plate 1. Art. 2. The moulinet; first position.

THE GUARDS.

1. Sword exercise, 2. GUARD.

3. The first command is executed as in the moulinets. At the second command, bend the forearm, and bring the hand to the



Plate 2. Art. 3. Right guard.

height of the right nipple and in front of the right shoulder, the elbow free from the body and slightly outside the hip, the point of the sword at the height of the chin, edge to the right; at the

same time advance the right foot twice its length, bend both knees slightly, body erect, the weight thrown a little more on the left leg than on the right, head erect, eyes to the front. This is the position of *right guard*. In the *left guard*, the sword is held edge to the left, finger nails up, the hand opposite the center of the body. (See plates 2 and 3.)

4. To change guard: 1. CHANGE GUARD.

Reverse the position of the hand, raising the point and drawing the hand back slightly, to pass over, and close to, the point of the opponent's sword.

5. The attacks and parries, to the left, are made from the position of *right guard only*, and vice versa.



Plate 3. Arts. 3-4. Left guard.

6. The *head* and *thrust attacks* and *parries* are made from the *right guard* only.

THE STEPS.

1. ADVANCE (or RETIRE); or, 1. Step right (or left). 2. STEP.

7. Executed as in the bayonet exercise. In the engagement and assault, one opponent advances when the other retires, and one steps to the right when the other steps to the left.

THE PARRIES.

1. Head, 2. PARRY.

8. Carry the point of the sword a little to the right, then drop it to the left and raise the sword quickly a few inches above the head, edge up, hand in front of the right ear, the point to the left, the sword inclined slightly downward. (See plate 4.)

1. *Right (or Left) cheek (or neck), 2. PARRY.*

9. (1) Carry the hand about ten inches in front and three inches to the right of the right cheek, edge to the right, point up, sword inclined slightly to the front.

(2) For the *neck parry*, lower the hand a few inches. (See plates 7 and 8, Art. 17.)

1. *Right flank, 2. PARRY.*

10. Describe a semi-circle from left to right with the point of the sword until it is a little to the right of the right knee, edge to the right, the hand to the right of the right hip and five inches below the right nipple, arm slightly bent. (See plate 10, art. 19.)

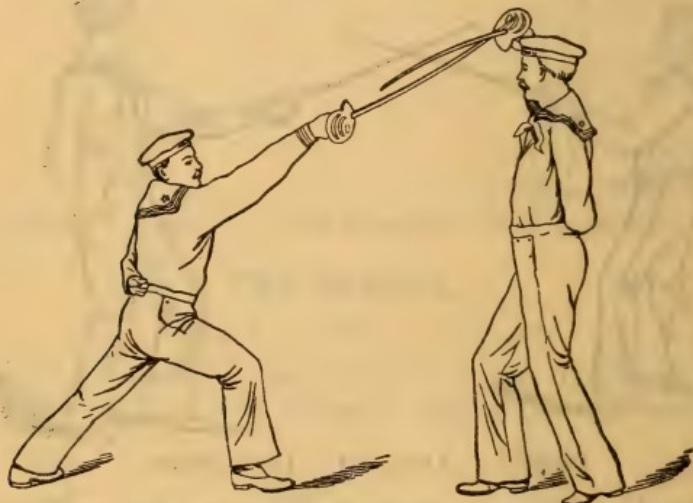


Plate 4. Arts. 8 and 16. Head attack and parry.

1. *Left flank, 2. PARRY; or, 1. Thrust, 2. PARRY.*

11. Carry the point of the sword slightly to the right, then drop the point to the left, the blade in line with the left knee and slightly to the front, sword edge to the left, the elbow and hand about the height of the breast. (See plates 9 and 11, Arts. 18 and 19.)

12. Attacks at the leg are not parried with the sword, but by moving the right toe to the rear of the left heel, legs extended; at the same time carry the upper part of the body forward and attack the opponent's head or cheek. This movement will be executed at the command: 1. *Right foot to the rear, 2. Head (or Right, or Left cheek), 3. ATTACK.* (See plates 5 and 6.)

SINGLE ATTACKS.

13. (1) All single attacks are made in two motions, the first motion being to disengage and extend the arm quickly in the di-



Plate 5. Art. 12. Leg attack; left cheek return.

rection of the attack; the second motion is a *lunge* and quickly follows the first.

(2) The command, *attack* (or *return*), is the signal for the first motion, and the command, *lunge*, for the second motion.

(3) A *feint* is made by omitting the second motion, or *lunge*.

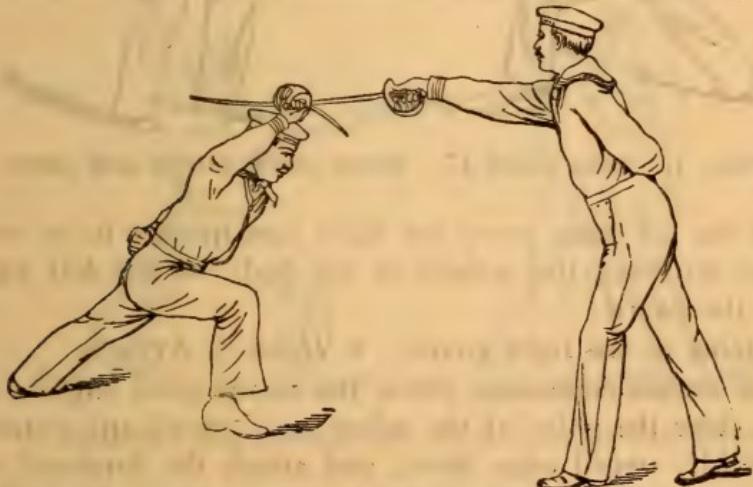


Plate 6. Art. 12. Leg attack; head return.

(4) In all attacks, except the *thrust*, disengage by drawing back slightly and reversing the hand, the point passing over and close to the opponent's sword, and then extend the arm quickly.

(5) In the *thrust attack*, disengage by dropping the point below and to the opposite side of the opponent's sword, and reverse the hand, if the guard is to the left; if the guard is to the right, the hand is not reversed.

14. (1) Having executed the first motion of an attack: LUNGE.

Carry the right foot forward about eighteen inches, grazing the ground; extend the left leg, body thrown slightly forward, head thrown slightly back, left hand remaining at the small of the back.

(2) The *lunge* will be executed in all attacks. In making an attack, the right hand is held as best to oppose a counter attack.

15. To resume the guard: GUARD.



Plate 7. Arts. 9 and 17. Right cheek attack and parry.

Bend the left knee, carry the right foot quickly to its original position, throwing the weight of the body on the left leg, and resume the *guard*.

16. Being at the right guard: 1. Head, 2. ATTACK.

At the second command, throw the sword point slightly to the rear to clear the point of the adversary's sword and extend the arm quickly, sword edge down, and attack the forehead of the adversary, hand at the height of the shoulder. (See plate 4, Art. 8.)

17. Being at the left or right guard: 1. Right (or Left) cheek (or neck), 2. ATTACK.

At the second command, disengage and extend the arm quickly, sword at the height of the cheek, or neck, edge to the right,



Plate 8. Arts. 9 and 17. Left cheek attack and parry.

and point directly for the middle of the face, or neck. (See plates 7 and 8.)



Plate 9. Arts. 11 and 18. Thrust attack and parry.

18. Being at right guard: 1. Thrust, 2. ATTACK.

At the second command, disengage and extend the arm quickly, point of the sword at the height of the breast, edge to the right, hand opposite the left breast. (See plate 9.)

19. Being at the left or right guard: 1. *Right (or Left) flank,*
 2. **ATTACK.**



Plate 10. Arts. 10 and 19. Right flank attack and parry.

At the second command, disengage and extend the arm quickly, lower the point to the height of the belt, edge to the right, and point at the flank. (See plates 10 and 11.)



Plate 11. Arts. 11 and 19. Left flank attack and parry.

20. After all attacks for the face, neck, or body, press with the thumb on the hilt and then withdraw the sword in an oblique direction to obtain a clear cut.

21. The parries and attacks are first taught separately and afterwards in combination, thus:

1. Head, 2. PARRY (or ATTACK), 3. GUARD, etc.
1. Head, 2. ATTACK, 3. LUNGE, 4. GUARD, etc.
1. Left cheek, 2. ATTACK, 3. LUNGE, 4. Right flank, 5. PARRY,
6. GUARD, etc.

RETURNS.

22. The attacks from the positions of the parries are called *returns*, and are made as follows: After the head parry: 1. Head (or, *Left cheek, neck, or flank*), 2. RETURN.

At the second command, describe a quarter-circle with the point above the head from left to right by way of the rear without disturbing the position of the hand; when the sword points directly to the rear reverse the hand, bringing the edge to the left, extend the arm quickly and finish the movement as for the head, cheek, neck, or left flank attack.

23. After the cheek or neck parry: 1. Right (or Left) cheek, (neck or flank), 2. RETURN.

Throw the point slightly to the rear to clear the point of the opponent's sword, then quickly turn the back of the hand up (or down) and attack in the designated direction.

24. After the right flank parry: 1. Thrust, 2. RETURN.

(1) Raise the hand, nails down, extend the arm quickly and thrust for the face or the upper part of the body.

(2) To parry this return, raise the sword, point to the left, and take the *head parry*.

25. After the left flank parry or thrust parry: 1. Head, 2. RETURN.

At the second command, execute a left moulinet and attack the forehead of the adversary, sword edge down, hand at the height of the shoulder.

26. The parries, attacks, and returns will next be taught in combination thus:

1. Left flank, 2. PARRY, 3. Head, 4. RETURN, 5. LUNGE, 6. GUARD.
1. Thrust, 2. ATTACK, 3. LUNGE, 4. Head, 5. PARRY, 6. GUARD.
1. Head, 2. ATTACK, 3. LUNGE, 4. Left cheek, 5. PARRY, 6. Right flank, 7. RETURN, 8. LUNGE, 9. GUARD, etc.

COMPOUND ATTACKS AND RETURNS.

27. (1) A compound attack, or return, consists of a *feint* followed by an *attack* or *return*, and will be taught after proficiency is attained in single attacks. For example:

- (2) Being at right guard: 1. *Left and right cheek*, 2. ATTACK,
3. LUNGE, 4. GUARD.

At the second command, *feint* for the left cheek, at which the opponent begins to *parry left cheek*; then reverse the hand quickly and attack the right cheek.

- (3) Being at head parry: 1. *Left and right cheek*, 2. RETURN,
3. LUNGE, 4. GUARD.

At the second command, *feint* for the left cheek, at which the opponent begins to *parry left cheek*; then reverse the hand quickly and attack the right cheek.

THE ENGAGEMENT.

28. (1) After careful instruction in the foregoing principles and movements, the engagement will be taught. The men will form in two ranks, take intervals, and the front rank will then be faced about.

(2) At the command, *sword exercise*, the front-rank men, in executing the movement, will place themselves in front of their rear-rank men, and at such a distance that the swords will overlap about six inches when on guard.

(3) In the engagement, the opponents' swords will be held edge to edge when on guard.

(4) The rank to attack will be designated in the command; the rank attacked will execute the *parry* and *return*.

(5) The *parry* will always be taken at a *feint*, or at the first motion of an attack.

Examples in Single Attacks.

29. (1) 1. *Front (or Rear) rank*, 2. *Step right*, 3. STEP.

At the third command, the designated rank executes *Step right*, and the other rank *Step left*.

- (2) 1. *Front (or Rear) rank*, 2. HEAD, 3. ATTACK, 4. LUNGE,
5. GUARD.

At the third command, the designated rank will *attack*, and the other rank will *parry*.

Examples in Single Attacks and Single Returns.

30. 1. *Front (or Rear) rank*, 2. HEAD, 3. ATTACK, 4. LUNGE,
5. *Left cheek (or neck)*, 6. RETURN, 7. LUNGE, 8. GUARD.

At the third command, the designated rank will *attack*, and the other rank will *parry*. At the sixth command, the rank attacked will *return*, and the opposing rank will *parry*.

Examples in Compound Attacks and Single Returns.

31. 1. *Front* (or *Rear*) *rank*, 2. *Left and right cheek*, 3. *ATTACK*, 4. *LUNGE*, 5. *Left cheek*, 6. *RETURN*, 7. *LUNGE*, 8. *GUARD*.

At the third command, the designated rank will *feint* and *attack*, and the other rank will *parry left and right cheek*. At the sixth command, the rank attacked will *return*, and the opposing rank will *parry*.

Examples in Single Attacks and Compound Returns.

32. 1. *Front* (or *Rear*) *rank*, 2. *Head*, 3. *ATTACK*, 4. *LUNGE*, 5. *Left and right cheek*, 6. *RETURN*, 7. *LUNGE*, 8. *GUARD*.

Examples in Compound Attacks and Compound Returns.

33. 1. *Front* (or *Rear*) *rank*, 2. *Right and left cheek*, 3. *ATTACK*, 4. *LUNGE*, 5. *Right and left cheek*, 6. *RETURN*, 7. *LUNGE*, 8. *GUARD*.

34. To repeat a movement, the commands of execution alone need be repeated; for example, to repeat the last movement: 1. *ATTACK*, 2. *LUNGE*, 3. *RETURN*, 4. *LUNGE*, 5. *GUARD*.

THE ASSAULT.

35. After careful instruction in all the principles and movements of the engagement, the instructor may permit the men to engage *at will* at the command, *assault*, provided that an outfit of masks is supplied for this purpose. The men must be cautioned to move the hand and sword as little as possible from the position of *guard*, in order to keep themselves covered; to watch the hand of the opponent instead of his eyes, and to attack close to his sword.

36. (1) To discontinue the engagement or assault, the instructor will command: 1. *Order*, 2. *SWORDS*, at which the men will resume the *order*.

(2) The men are assembled as in the drill regulations.

To Dismiss.

37. Having assembled: 1. *Carry*, 2. *SWORDS*, 3. *DISMISSED*.

BAYONET EXERCISE.

NOTE.—Prepared by Professor A. J. Corbesier, Sword Master at U. S. Naval Academy.

To Take Intervals or Distance.

38. Intervals or distances are taken as prescribed in the drill regulations.

The Guard.

39. Intervals or distances having been taken, and the squad being at the *order*, bayonets fixed, the instructor commands: 1. *Bayonet exercise*, 2. GUARD.

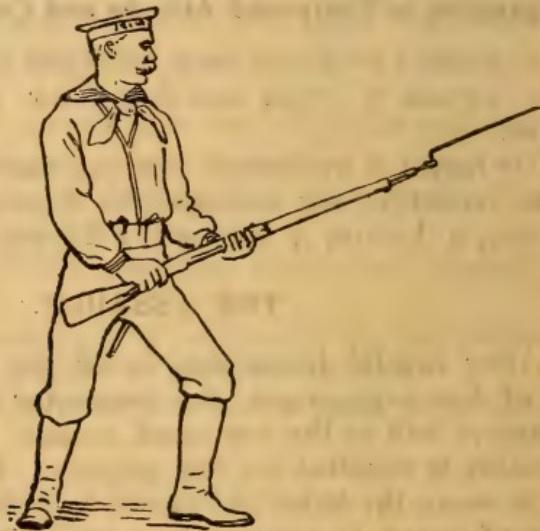


Plate 12. Art. 39. The guard.

At the first command, pieces are brought to the *port*; at the second command, half face to the right, carry back and place the right foot about twice its length to the rear, the hollow of the right foot in rear of the left heel, the feet at a little less than a right angle, the right toe pointing to the right, both knees slightly bent, body erect on the hips, the weight thrown a little more on the right leg than on the left; at the same time throw the point of the bayonet to the front, at the height of the chin, barrel to the left, the small of the stock directly in front of the center of the body below the belt, the left hand below the sight with the thumb along the barrel, both arms free from the body, without constraint.

40. Being at guard: 1. *Order*, 2. ARMS.
Resume the *order* as from charge bayonet.

The Steps.

41. ADVANCE: Move the left foot quickly forward eight inches; follow with the right foot the same distance.

42. RETIRE: Move the right foot quickly to the rear eight inches; follow with the left foot the same distance.

43. 1. *Step right*, 2. STEP: Move the right foot quickly to the right eight inches; follow with the left foot to its relative position in front.

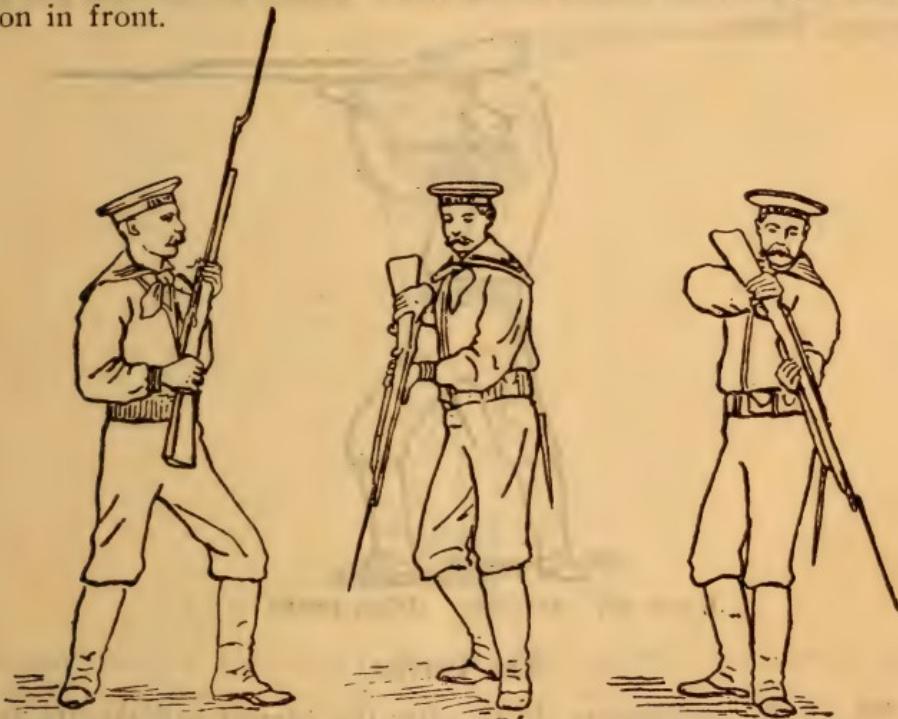


Plate 13. Art. 47.
Facings. First position.

Plate 14. Art. 52.
Right low parry.

Plate 15. Art. 53.
Left low parry.

44. 1. *Step left*, 2. STEP: Move the left foot quickly to the left eight inches; follow with the right foot to its relative position in rear.

45. 1. *Front*, 2. DOUBLE: Advance the right foot quickly eight inches in front of the left, keeping the right toe to the right; then advance the left foot to its relative position in front.

46. 1. *Rear*, 2. DOUBLE: Carry the left foot quickly eight inches to the rear of the right; then place the right foot in its relative position in rear.

The Facings.

47. 1. Face right (or left), 2. FACE: At the first command, bring the piece quickly to the *port*; at the second command, face to the right, turning on the ball of the left foot, at the same time carry the right foot quickly to its relative position in rear and resume the guard.

48. 1. Right (or Left) about, 2. FACE: Similarly executed, facing about on the ball of the left foot.

49. The foregoing movements are first executed without arms, hands on the hips, fingers to the front, thumbs to the rear, elbows pressed back.

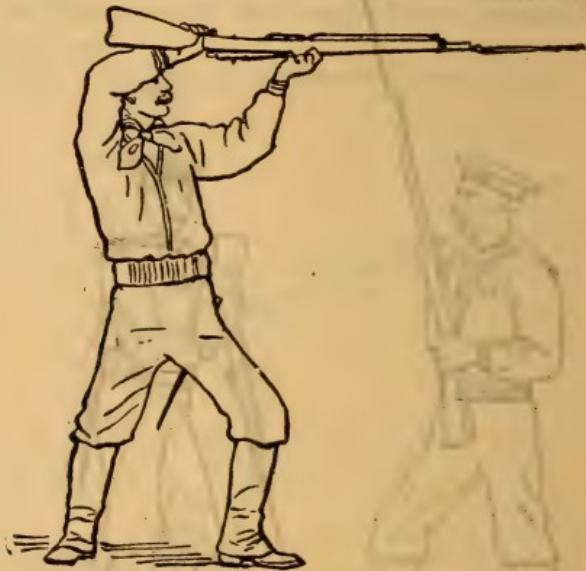


Plate 16. Art. 54. High parry.

The Parries.

50. In the preliminary drills, after the *parries* and *thrusts*, the position of *guard* is resumed, by the command, GUARD! after each movement.

51. 1. Right (or Left), 2. PARRY: Move the point of the bayonet quickly about six inches to the right.

52. 1. Right low, 2. PARRY: Raise the butt outside the right forearm, the right hand at the height of the breast; at the same time describe a semi-circle from left to right with the point of the bayonet until it is at the height of, and a little to the right of, the right knee; barrel to the left.

53. 1. Left low, 2. PARRY: Lower the point of the bayonet, describing a semi-circle, and carry it to the left at the height of,

and a little to the left of, the left knee; barrel to the left, the right hand opposite the left breast.

54. 1. High, 2. PARRY: Raise the piece quickly with both hands, the right hand three inches in front of, and four inches above, the head; the barrel down and supported between the thumb and forefinger of the left hand above the sight, the piece directed to the front with the point of the bayonet opposite the left shoulder; at the same time bend both knees slightly more than in the position of *guard*.

55. 1. High right (or left), 2. PARRY: Executed in the same

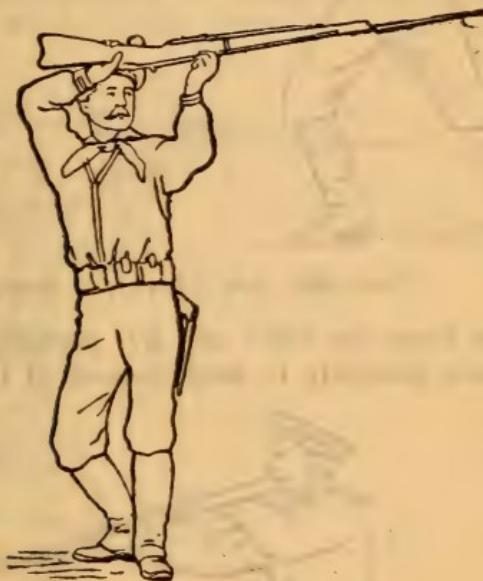


Plate 17. Art. 55. High left parry.

manner as the *high parry*, except that the left shoulder is advanced, and the point of the bayonet directed to the right.

56. (1) In the different *parries*, the piece should be so held as to cover the point attacked.

(2) When the men have become proficient, they will be instructed to resume the *guard* without command.

The Thrusts.

57. (1) 1. Straight, 2. THRUST: Carry the upper part of the body forward, advance the right shoulder, straighten the right leg, and bend the left knee; at the same time thrust the piece directly to the front to the full length of the right arm, slipping it through the left hand, barrel up, the bayonet and the butt at height of the chin.

(2) The *straight thrust* should be executed frequently in order to strengthen the wrist. It may be executed directly from the



Plate 18. Art. 57 (1). Straight thrust.

guard, or from the *right* and *left parries*, and the *guard* should be resumed promptly to keep control of the piece. In *thrusting*,

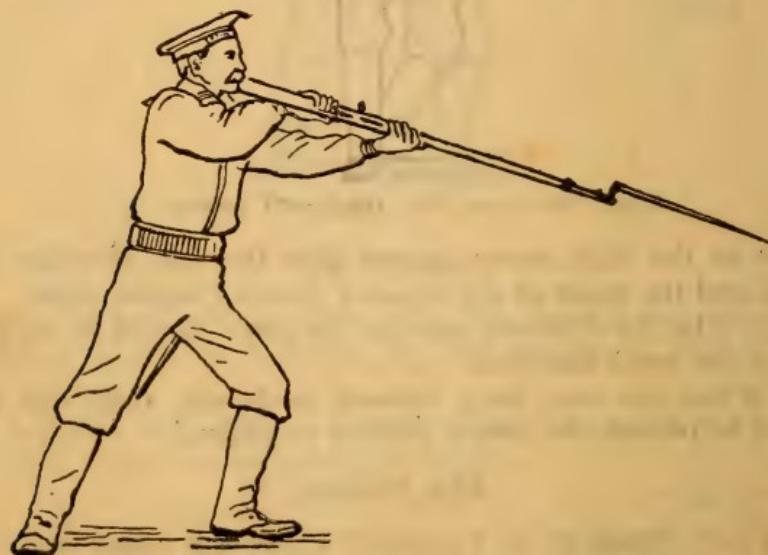


Plate 19. Art. 58 (3). Right low thrust.

the piece must be held so as to cover the point most exposed to the enemy's attack.

58. (1) The *thrusts* from the different *parries* are made with

the right leg always straightened, and the body carried forward as in the *straight thrust*.

(2) 1. Right (or Left). 2. PARRY, 3. THRUST, 4. GUARD. Execute the *straight thrust*.

(3) 1. Right low, 2. PARRY, 3. THRUST, 4. GUARD. Thrust to the full extent of the left arm, barrel to the left, bayonet at the height of the waist, right hand at the height of the breast, keeping the left hand fast, stock outside the right forearm.

(4) 1. Left low, 2. PARRY, 3. THRUST, 4. GUARD. Thrust to the full extent of the left arm, barrel to the left, bayonet at the height of the waist, right hand at the height of the breast, keeping the left hand fast, stock outside the right forearm.



Plate 20. Art. 59. High thrust.

(5) 1. High (or High right, or High left), 2. PARRY, 3. THRUST, 4. GUARD. Thrust in the designated direction to the full extent of the left arm, barrel down, right hand above, and in front of, the head, keeping the left hand fast.

(6) The command for the *thrust* quickly follows the *parry*.

59. In the same manner a *thrust* may be executed directly from the position of *guard*, in the direction of any *parry*, by one command: 1. High, 2. THRUST, 3. GUARD; or, 1. Right low, 2. THRUST, 3. GUARD, etc.

60. 1. Low right, 2. SHORT: Throw the body backward, straighten the left leg and bend the right knee; at the same time draw

the piece back quickly to the full length of the right arm, lowering the butt about six inches below the right hip, slipping the left hand up to the upper band, barrel up, left hand at the height of the hip, right hand at small of the stock.

61. (1) 1. Low right, 2. SHORT, 3. THRUST (or STRAIGHT THRUST): Throw the body forward on the hips, straighten the right leg, and bend the left knee; at the same time thrust the piece forward quickly to the full length of the left arm without moving the hands, barrel up, both hands at the height of the waist.

(2) Should the adversary retreat, the *straight thrust* must be used.



Plate 21. Art. 60. Low right short.

(3) Being at low right short: to *parry*, move the point of the bayonet as in *right* or *left parry*, without moving the hands.

To Use the Butt.

62. BUTT TO FRONT: Raise the piece nearly vertical and bring it back, barrel in the hollow of right shoulder, strike quickly the butt to the front, straighten the right leg, barrel resting on the shoulder.

63. BUTT TO RIGHT (or LEFT): Face right (or left) and proceed as in *butt to front*. In resuming the *guard*, face left (or right).

64. (1) BUTT TO REAR: Turn to the right on both heels, keeping the feet nearly at a right angle, right toe to the rear, at the same time raise the piece over the left shoulder, barrel down

and horizontal, back of right hand against left side of neck, left hand near lower band, left leg straight; strike quickly the butt to the rear.



Plate 22. Art. 61. The low right short, thrust.

(2) In resuming the *guard*, turn to the left on both heels, and bring the left toe to the front.

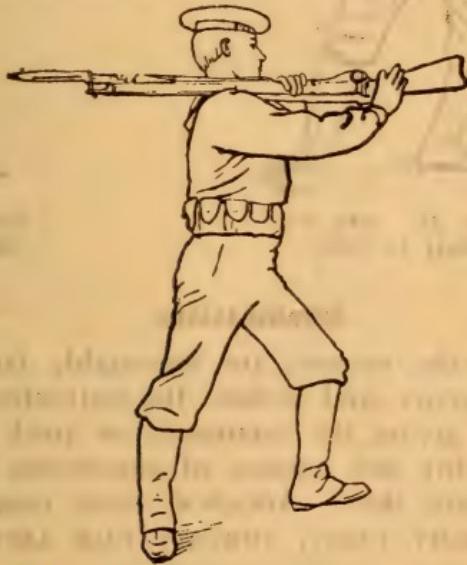


Plate 23. Art. 62. Butt to front.

To Change Guard.

65. (1) 1. *Change guard*, 2. REAR; Turn to the right on both heels, raising the toes, and face quickly to the rear; at the same time raise the point of the bayonet in a semi-circle, and throw

the piece to the rear, releasing it for an instant with both hands and then grasp it again with the hands interchanged, the right hand below the sight and the left at the small of the stock, the barrel to the right in the position of *guard*.

(2) The *parries* and *thrusts*, *facings*, *steps*, and other movements may then be executed according to the foregoing principles.

(3) To resume the original front, the commands are the same, and the movement is executed in a similar manner.

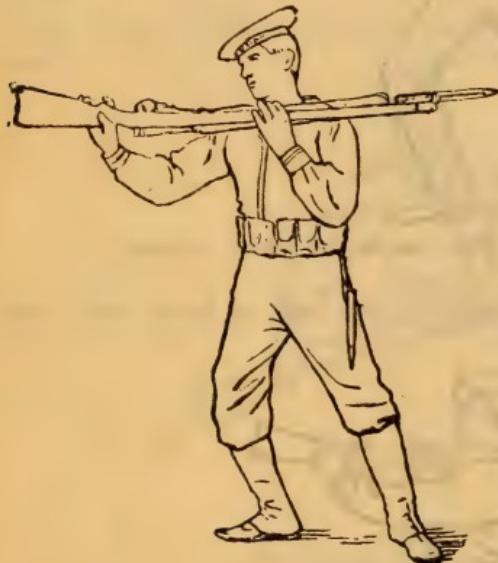


Plate 24. Art. 64.
Butt to rear.



Plate 25. Art. 65.
Change guard rear.

Combinations.

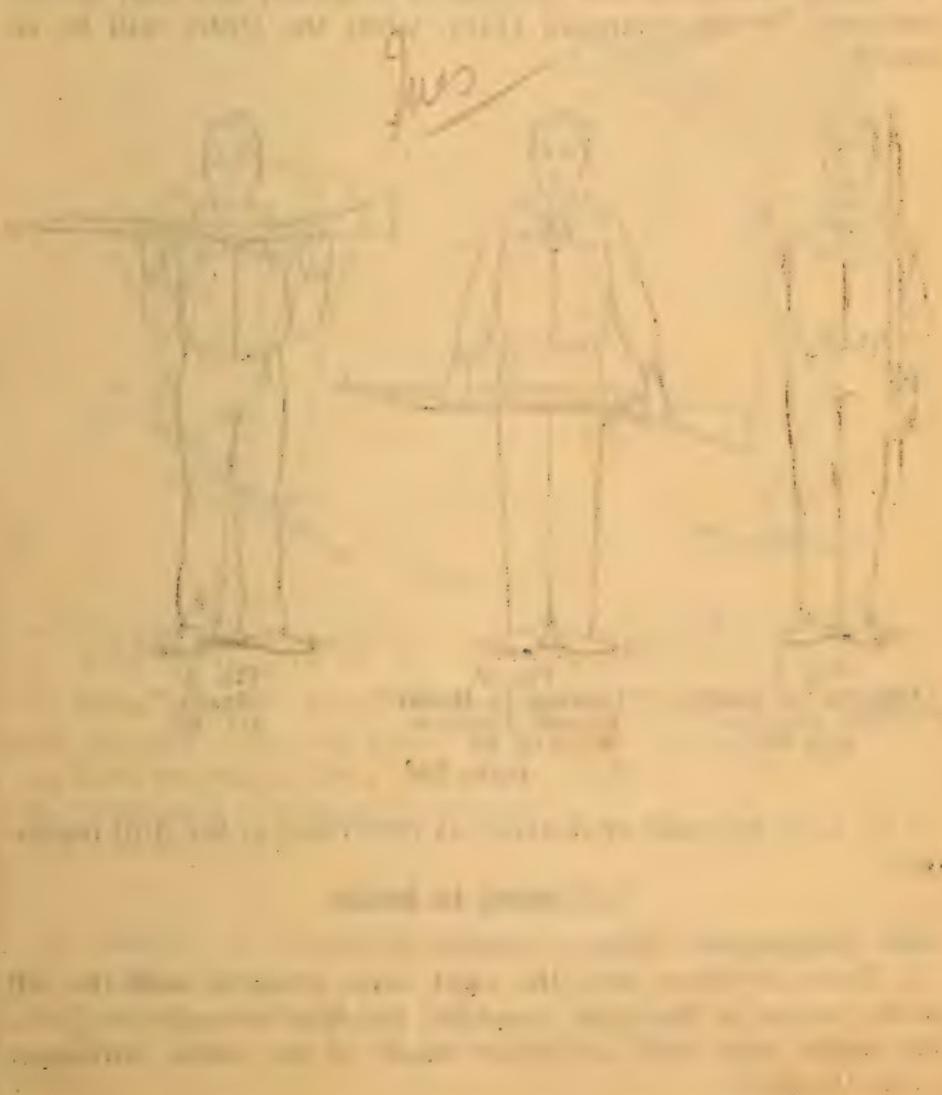
66. (1) When the recruits are thoroughly familiar with the different *steps*, *parries*, and *thrusts*, the instructor combines several of them by giving the commands in quick succession, increasing the rapidity and number of movements in combination as the men acquire skill: ADVANCE, HIGH PARRY, THRUST; or FRONT DOUBLE, RIGHT PARRY, THRUST; FACE LEFT, HIGH PARRY, THRUST, etc.

(2) The *guard* is resumed without command.

67. (1) Every movement to the front should be followed by a *thrust*; every movement to the rear by a *parry*.

(2) The cautionary command, *attack*, may be used preceding a combination of movements.

- (3) To repeat a combination, the numerals *one, two, three, etc.*, may be used instead of repeating the commands.
- (4) It is intended merely to prescribe the manner of executing the movements laid down, but not to restrict the number of movements, leaving to the discretion of c. cs. and the ingenuity of instructors the selection of such other exercises as accord with the object of the drill.
- (5) As soon as the movements are executed accurately, the commands are given rapidly, expertness in the bayonet exercise depending mostly on quickness of motion.



PHYSICAL DRILL UNDER ARMS.

From the Manual of Physical Drill by Chaplain W. O. Holway, U. S. N.

General Rules.

68. (1) All movements in this section are 4-counts, and, except "Coming to ready," are performed two (or four) times.

(2) The exercises may be executed by command, or to music, or silently following the motions of a leader, and may be discontinued by the command HALT, when the *Order* will be resumed.

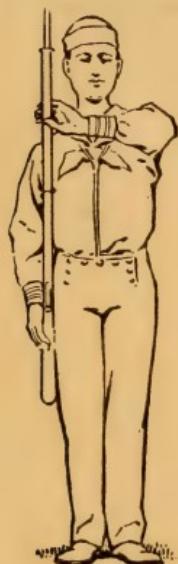


Fig. 1.
"Coming to Ready,"
First Position.
Art. 69.

Fig. 2.
"Coming to Ready,"
Second Position.
Art. 69.

Fig. 3.
"Ready."
Art. 69.

Plate 26.

(3) Take intervals or distance as prescribed in the drill regulations.

1. Coming to Ready.

69. Commands: *Come to ready—1, 2, 3.*

1. Raise the piece with the right hand, grasp it with the left at the height of the right shoulder, knuckles towards the body. The right hand will grasp the small of the stock, forefinger under the guard.

2. Let the piece drop in front of the body to a horizontal, slings down, keeping body erect.

3. Raise the piece horizontally to the height of the shoulders, slings up, at the same time moving the left foot to the left about twelve inches. Keep the chest out, and the shoulders well back. This position is *Ready*, and is the starting point of all the movements under arms.

2. Down and Forward.

70. SPECIAL ACTION.—The muscles of the hips, back and arms. Commands: *Down and Forward*—1, 2, 3, 4; 1, 2, 3, 4, etc.



Plate 27.

Fig. 1.

"Down and Forward," End of
First Count. Art. 70.



Fig. 2.

"Down and Forward," End of
Third Count. Art. 70.

1. From *Ready*, lower the piece horizontally to the insteps, keeping arms and knees (if possible) straight.

2. Back to *Ready*, chest out, elbows back.

3. Push piece horizontally forward.

4. Back to *Ready*.

3. Forward and Up.

71. SPECIAL ACTION.—The muscles of the arms, and of side walls of the chest.

Commands: *Forward and Up*.—1, 2, 3, 4; 1, 2, 3, 4.

1. From *Ready*, push out horizontally forward, as in the last exercise.

2. Back to *Ready*, chest out, elbows back.
3. Push the piece to high vertical, keeping it horizontal, and expanding chest.
4. Back to *Ready*.

4. Up and Shoulders.

72. SPECIAL ACTION.—The muscles of the arms, and of the side and front walls of the chest.



Plate 28.

"Forward and Up," Third Count.
Art. 71.



Plate 29.

"Up and Shoulders," Second Count. Art. 72.

Commands: *Up and Shoulders*—1, 2, 3, 4; 1, 2, 3, 4.

1. From *Ready*, push the piece to vertical, as in last exercise.
2. Lower piece to back of shoulders, head up, elbows well back.
3. Up again to vertical.
4. Down to *Ready*.

5. Side Pushes.

73. SPECIAL ACTION.—The rotary muscles of the body and thighs; the loin muscles.

Commands: *Side Pushes*—1, 2, 3, 4; 1, 2, 3, 4.

1. From *Ready*, push the piece horizontally to right side,

twisting the body, keeping the eyes on the piece, but keeping the heels firmly on deck.

2. Back to *Ready*, chest out, elbows back.
3. Push the piece to the left side.
4. Back to *Ready*.

6. Diagonal Lunges.

74. SPECIAL ACTION.—The muscles of the arms, back and legs.
Commands: *Diagonal Lunges*—1, 2, 3, 4; 1, 2, 3, 4.

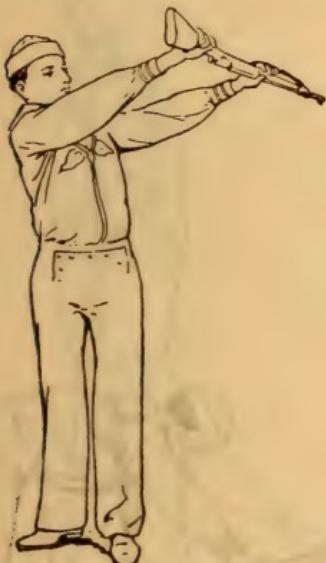


Plate 30.
"Side Pushes," Third Count.
Art. 73.



Plate 31.
"Diagonal Lunges," First Count.
Art. 74.

1. From *Ready*, lunge diagonally to the right, about thirty-six inches, with the right leg, at the same time bringing the piece up horizontally to 45 degrees. The left foot should be flat, and the eyes directed to the piece.
2. Back to *Ready*, chest out, elbows back.
3. Lunge to the left with left leg, as above.
4. Back to *Ready*.

7. Forward Lunges.

75. SPECIAL ACTION.—The muscles of the arms and legs and the side walls of the chest.

Commands: *Forward Lunges*—1, 2, 3, 4; 1, 2, 3, 4.

1. From *Ready*, lunge directly to the front, about thirty-six inches, with right leg, at the same time raising piece horizontally to vertical, and directing the eyes to the piece. Keep left foot flat.
2. Back to *Ready*.
3. Lunge to the front with left leg, as above.
4. Back to *Ready*.

8. Front Sweeps.

76. SPECIAL ACTION.—All the principal posterior muscles of the body.



Plate 32.
"Forward Lunges," Third Count.
Art. 75.



Plate 33.
"Front Sweeps." Art. 76.

Commands: *Front Sweeps, Slow*—1, 2, 3, 4; 1, 2, 3, 4.

1. From *Ready*, raise the piece horizontally to high vertical, keeping chest well out, and emphasizing the up-stretch.
2. Lower the piece slowly in front semi-circle to insteps, keeping the arms straight and emphasizing the out-reach.
3. Raise the piece slowly in front semi-circle to vertical.
4. Down to *Ready*.

9. Overhead Twists.

77. SPECIAL ACTION.—The rotary muscles of the upper part of the body; also stimulates the venous circulation.

Commands: *Overhead Twists, Butt Forward—1, 2, 3, 4; Muzzle Forward—1, 2, 3, 4.*

1. From *Ready*, raise the piece overhead, at the same time twisting it till the butt points directly forward. Keep the piece horizontal.

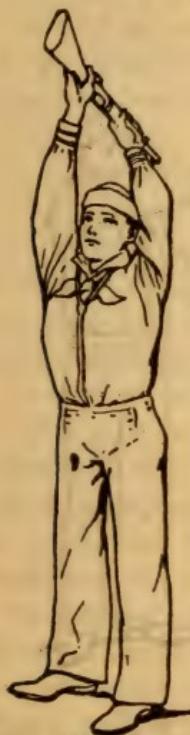


Plate 34.

Fig. 1.
"Overhead Twists,"
Butt Forward.
Art. 77.

Fig. 2.
"Overhead Twists," Muzzle Forward.
(Side view.) Art. 77.

2. Twist the piece to the right until the muzzle points directly forward. Hold the hips firmly forward, confining the movement to the upper part of the body.

3. Twist back till the butt points directly forward.

4. Lower the piece to *Ready*.

1. From *Ready*, raise the piece overhead, at the same time twisting it till the muzzle points directly forward.

2. Twist the piece to the left until the butt points directly forward.
3. Twist back until the muzzle points forward.
4. Lower the piece to *Ready*.

10. Side Twists.

78. SPECIAL ACTION.—The muscles of the sides, loins and small of the back.

Commands: *Side Twists*—1, 2, 3, 4; 1, 2, 3, 4.

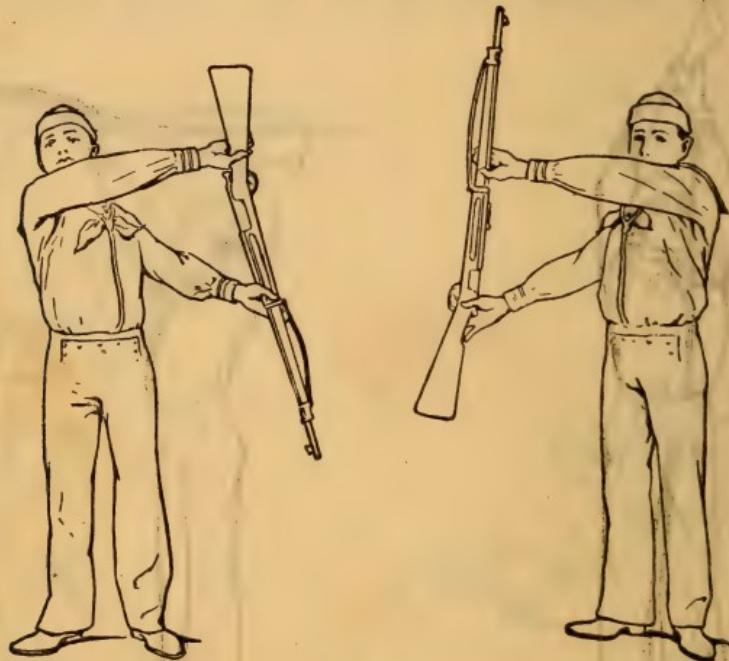


Plate 35.

Fig. 1.

"Side Twists," Second Count.
Art. 78.

Fig. 2.

"Side Twists," Fourth Count.
Art. 78.

1. From *Ready*, drop the piece horizontally in front to position No. 2 in *Coming to Ready*.
2. Lifting the butt up, carry the piece strongly to the left side and out, muzzle pointing directly down. Keep the hips firm.
3. Return the piece to position No. 2 in *Coming to Ready*.
4. Lifting the muzzle, carry the piece strongly to the right side and out, muzzle pointing directly up.

Repeat the exercise.

At the end of Exercise 10, come to *Order Arms*.

PHYSICAL DRILL WITHOUT ARMS.

GENERAL INSTRUCTIONS.

79. (1) It should be clearly understood that these instructions are *not simply for the purpose of providing "exercise,"* that is, an amount of physical exertion sufficient to keep the bodily functions in good working order, since that is secured in most cases by the routine work of the ship.

(2) The primary object is *to cause every man on board ship really to exert all of his muscles daily*, in order that he may increase or maintain their development and suppleness, and to correct the most common physical defects that result from neglect of *systematic exercise*. A man in perfect health and of powerful physique may lack suppleness and erectness, and may have many imperfectly developed muscles and small lung-capacity.

(3) In order that the object of these exercises may be achieved—that all the muscles may be properly disciplined—it is absolutely essential that the exercises be carried out vigorously, so as to bring a very considerable strain upon all of the muscles involved; otherwise the desired object will not be accomplished. *It is therefore enjoined upon all officers concerned to exert themselves to prevent these exercises degenerating into perfunctory and spiritless motions, which serve no useful purpose.* To this end, division-officers and others directly concerned in this training should set an example of enthusiasm for physical development by carrying out the exercises themselves.

(4) As it is essential to success that *the interest of the men be maintained*, the exercises should not be carried out under conditions which render this impossible; for example, when the weather is so hot and sultry as to render physical exertion distressing, or when the men have been unusually fatigued by necessary work or exposure.

(5) As the object of all physical exercises on board ship is that each man be kept in the best possible physical condition, it should be an inflexible rule that *no man or petty officer will be excused on account of age, obesity, or any other reason, except*

temporarily when authorized by the commanding officer, upon the recommendation of the medical officer; for while some men are capable of more exertion than others, all should be obliged to carry out each exercise thoroughly as far as they are able.

(6) While most of the exercises specified below are such that they cannot be performed without considerable muscular exertion, it should nevertheless be explained that their value can be much increased by exerting one set of muscles against another, thus keeping all the muscles of the body on a strain during each exercise. This requires concentration of will power and a desire on the part of each man for physical improvement.

(7) As this desire for improvement is the key-note of all physical training, each officer concerned should endeavor to create in the minds of his men a pride in their physical condition. To this end the men should be impressed with the importance of a *correct position of the trunk, chest, head and shoulders*, and it should be enjoined upon them to carry themselves erectly at all times. Stooping and rounded shoulders indicate weak back and abdominal muscles and contracted lung-space, and unless these defects are corrected it is not possible to achieve a satisfactory muscular development.

(8) For all exercises in which considerable exertion is required, as in running or in rapid marching, all authorities agree as to the importance of correct breathing. The men should therefore be instructed to use the full capacity of the lungs and to breath through the nose. If a habit is formed of taking a short, panting breath, neither the lungs nor chest will be properly developed; and those who habitually breath through the mouth will have much less endurance in running or marching, as the tongue and throat become parched; and this will sometimes be complicated by the irritation caused by dust. Like all other parts of the body, the lungs and chest can be developed only by systematic exercise carried to a reasonable point of strain, and neglect of this exercise frequently results in such a small lung-capacity as seriously to diminish the military usefulness of otherwise strong men. *The breathing exercise given below will produce the necessary development only when it is carried out conscientiously by each individual.* The benefit to be derived from it will therefore depend largely upon the success of officers in inspiring their men with a desire for improvement.

FORMATIONS AND COMMANDS.

80. (1) Except where specified to the contrary, these exercises may be executed by command, or to music, or silently, following the motions of the leader, and may be discontinued by the command, HALT, when the position of *Attention* will be resumed.

(2) Form the squad or division and take intervals or distance as prescribed in the infantry drill regulations.

(3) Throughout the following exercises, when it is directed to place *hands on hips*, the fingers will be to the front, thumbs to the rear, and elbows pressed well back. The position of *Attention* will be the same as prescribed in the infantry drill regulations.



Plate 36. Art. 80 (3).
Attention.



Plate 37. Art. 80 (3).
Hands on hips.

1st Exercise—Chest and Shoulder Muscles.

81. Commands: *Arms in Circle!* CIRCLE! HALT!

(1) At the command *Arms in Circle*, raise arms laterally until horizontal, fists closed, back of hands down.

(2) At command CIRCLE!, swing arms in a circle, first up and forward, then backward and down, arms making at all times an angle of 45 degrees with the position assumed at first command, and continue until the command *Halt*. Head and eyes to the front, chin in, body erect, shoulders square, chest out.

(3) HALT! resume *Attention*.

2d Exercise—Heart, Lungs, and Breathing Muscles.**82. Commands: *Breathing!* 1, 2, 3, HALT!**

At the command *Breathing*, take position *hands on hips*.

(1) Draw the breath in slowly and regularly through the nose until the lungs are completely inflated, at the same time raising the chest as high as possible.

2. Hold the breath, relaxing the muscles that raise the chest and exert a downward pressure.

3. Allow the breath slowly to escape through the nose.

Repeat the exercise as often as may be necessary.

HALT! resume *Attention*.



Plate 38. Art. 81.
Arms in circle.
1st position.

The intervals of time occupied in inhaling, holding and exhaling the breath, will be varied to correspond with the development which the men have reached.

3d Exercise—Back, Buttock, Hip and Abdominal Muscles.**83. Commands: *Full Sweep!* 1, 2, HALT!**

At command *Full Sweep*, raise arms vertically over the shoulders, fists closed, nails to the front, head erect, and eyes to the front.

1. Bend the body forward slowly until the knuckles touch the deck, legs straight, feet square on deck.

2. Raise the body slowly, arms vertical over the shoulders; then bend body back on hips as far as possible, eyes directed at the hands.

Repeat exercise as often as may be necessary.

HALT! (given from second position). Open hands and force arms obliquely back, gradually letting them fall to the sides, and resume *Attention*.



Plate 39. Art. 83. Plate 40. Art. 83 (1). Plate 41. Art. 83.
Full sweep. Full sweep. Full sweep.
1st position. 2d position. Executing halt.



4th Exercise—Neck, Abdominal, Back and Hip Muscles.

84. Commands: *Side Stoop!* 1, 2, 3, 4, **HALT!**

At command *Side Stoop*, place tips of fingers on top of shoulders, elbows back, left foot carried 12 inches to left.

1. Raise the right arm vertically, and at the same time bend the body to the left, touching the deck beside the left heel with the left hand. Keep the right knee straight, head up, and eyes directed upward to the right hand.

2. Assume position as at command *Side Stoop*.

3. Raise the left arm vertically, bend to the right and touch the deck beside the right heel with the right hand, keep the left knee straight, turning head and eyes upward.

4. Resume position taken at command *Side Stoop*.
 Repeat this exercise as often as may be necessary.
 HALT! resume *Attention*.

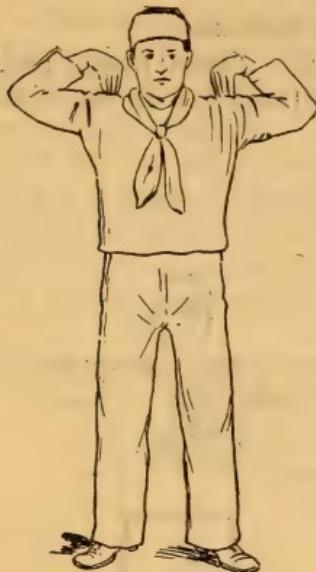


Plate 42. Art. 84.
Side stoop.
 1st position.



Plate 43. Art. 84 (1).
Side stoop.
 2d position.

5th Exercise—Neck, Back and Abdominal Muscles.

85. Commands: *Body Circle!* 1, 2, 3, 4, HALT!
 At command *Body Circle*, place *hands on hips*.

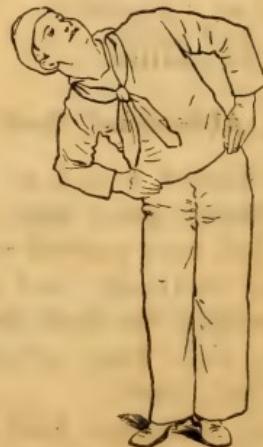
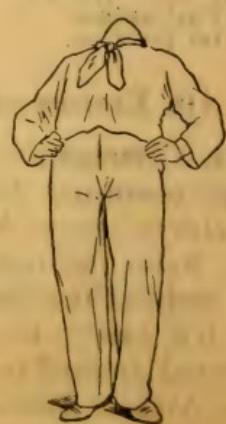


Plate 44. Art. 85 (1). Plate 45. Art. 85 (2). Plate 46. Art. 85 (3).
Body circle.
 1st position. 2d position. 3d position.



1. Bend body to front, elbows pressed well back, chest out, head erect, eyes to the front.
2. Bend body to right, cast eyes vertically up over left shoulder, elbows pressed well to the rear.
3. Bend body well back, chest out, head and eyes thrown back.
4. Bend body to left, eyes cast vertically up over right shoulder, elbows pressed well back.

Continue the motions as long as may be necessary.

HALT! resume *Attention*.



Plate 47. Art. 86.
Lunge. 1st position.



Plate 48. Art. 86 (1).
Lunge to the right.

6th Exercise—Leg, Thigh, Shoulder, Arm and Forearm Muscles.

86. Commands: *Lunge!* 1, 2, 3, 4, **HALT!**

At command *Lunge*, close fists and raise them to the nipples.

1. Extend quickly the left leg, keeping the left foot fast, lunge to the right at an angle of 45 degrees, carry the right foot 36 inches to the new front, foot grazing the deck, knee vertically over the right foot, body erect, head thrown back, left arm extended to the rear about three inches from the left thigh, left fist closed, right arm extended in the direction of the lunge, fist closed and at the height of the eye, knuckles down.

2. Resume position assumed at command *Lunge*.

3. Repeat 1, except lunge 45 degrees to the left, raising left hand, and keeping right foot fast.

4. Resume position assumed at *Lunge*.

Repeat exercise as often as may be necessary.

HALT! resume *Attention*.

7th Exercise—Leg, Thigh and Hip Muscles.

87. Commands: *Knee Stoop!* 1, 2, *HALT!*

At command *Knee Stoop*, place hands on hips.

1. Bend knees obliquely out, keep body vertical, rise on balls of feet, and lower body down until thighs touch heels. Keep shoulders and head back, body erect, chin in.



Plate 49. Art. 87 (1).
Knee stoop.

2. Rise slowly to position *hands on hips*.

Repeat exercise as often as may be necessary. This exercise should be executed slowly and deliberately.

HALT! resume *Attention*.

8th Exercise—Arm, Shoulder and Chest Muscles; General Exercise.

88. Commands: *Leaning Rest!* 1, 2, 3, 4, *HALT!*

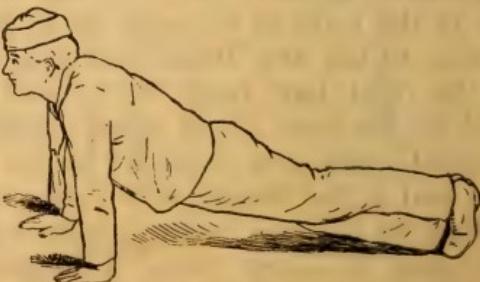


Plate 50. Art. 88 (1).
Leaning rest.
1st position.

Plate 51. Art. 88 (2).
Leaning rest.
2d position.

1. Stoop and place hands on the deck outside of the feet, head up and eyes to the front.
2. Slide the feet backward to the *Leaning Rest*, weight of body resting on toes and hands, body and legs straight, head up and eyes to the front.
3. Lower body until nearly touching deck, head up, eyes to the front.

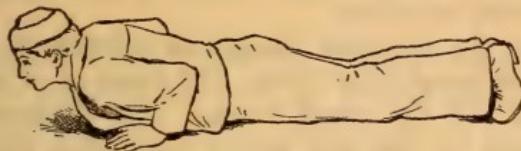


Plate 52. Art. 88 (3).
Leaning rest.
3d position.

4. Straighten arms and resume position *Leaning Rest*. Repeat 3 and 4 as often as may be necessary.
- HALT!** bring feet up to hands as in position 1, then rise to *Attention*.

RUNNING EXERCISE.

89. While the foregoing will exercise all the muscles of the body, *running* is superior to all others as a general exercise. For this reason it should be carried out daily, when practicable.

9th Exercise—Heart and Lungs; Leg and Thigh Muscles; General Exercise.

90. Commands: *Running Exercise! Form for Running!*
MARCH! HALT!

(1) In whatever formation the division may be, either extended or close order, at the command *Form for Running*, the division assumes the previously determined formation for this exercise (either single or double rank) faces to the right or left, bring hands to nipples.

(2) At command **MARCH!** step off with left foot on a run.

(3) This exercise will not be carried out to music at the ordinary double time, but the men will simply run without any effort to maintain step or close formation, and the pace will be sufficiently rapid to force the men to run upon their toes; and to further increase the amount of muscular exertion required, hurdles will be improvised, with division-chests, capstan-bars, etc., and the men will be required to leap over them. Each division,

or squad, should be led by a pace-maker, preferably an officer. This exercise should not be carried to the point of distress in the case of any man, but as some men are much less capable of such exertion than others, due principally to lack of lung-capacity, the latter will be allowed to fall out, when distressed, long enough to catch their "wind." After running a certain number of minutes, the squad or division may be halted for a short breathing spell; then resume exercise.

(4) Some of the hurdles should be placed at such a height that all men can jump over them, and some at a height that will try the strength of the most active. The higher hurdles need not be attempted by the less active men until they feel able to clear them, which the spirit of competition will induce them to do as soon as possible.

(5) As the spar-deck plans of ships differ widely in their arrangement, it will not be possible to prescribe in detail the manner in which running exercises will be carried out, but the following general principles will be observed: (a) the number of men running on any one route will not be so great as to cause crowding; (b) as many routes as practicable will be established, and these routes may be across hatches, etc.; (c) if desirable the crew may be divided into two or more parts, preferably by divisions, one only occupying the routes while the other part, or parts, stand by to replace them. This can be done without considerable loss of time, as one section can be resting while another is running. Practical experience has shown that where men are properly instructed and led by their officers, they take a great interest in this exercise.

(6) At the command HALT! the leader continues until he reaches the assigned position for the division formation, and halts. The others close up, halt and face to the front in double or single rank as may be designated.

THE COCK FIGHT.

91. (1) The running and jumping exercises above described may be varied with advantage by the "cock fight," that is practiced in the U. S. Army.

(2) For this exercise the men of a division, or squad, are drawn up in two ranks, facing each other, and with as great an interval between ranks as possible, not exceeding six paces. When convenient, about half of each division, or squad, may be engaged in this exercise at one time, the remainder being allowed

to witness the sport while waiting to take the place of the first half, when fatigued. Neither those engaged in the exercise nor those witnessing it should be required to maintain silence.

10th Exercise—Heart and Lungs; Leg and Thigh Muscles; General Exercise.

92. Commands: *Cock Fight! Right (or Left) Foot! Hop!*
HALT!

(1) At command *Cock Fight*—to be given only when men are deployed, as for bayonet exercise or setting up drills—the front rank will face about, and both ranks open to as much distance



Plate 53. Art. 92 (2).
Cock fight. Right foot.

as is available, not exceeding six paces. Then proceed as laid down.

(2) At the command *Right (or Left) Foot*, the men raise the left (or right) foot, fold the arms and keep them folded throughout the exercise. At the command *Hop*, they hop forward on the right foot and endeavor to knock any of their opponents down, or force them, by butting with the shoulder, to strike the deck with the raised foot. As soon as any man touches the deck with his raised foot, or is knocked over, or is in any way forced to use outside assistance to maintain his equilibrium, he must fall out of the game. After a minute or two of the exercise, the command *HALT!* is given and all that remain in the game return to their positions, the others falling back clear of the contestants.

(3) The command for hopping on the other foot is then given, and all hop forward and resume the exercise, which is continued until all of one side or the other have been forced to retire. When a certain amount of proficiency has been attained, contests should be organized between divisions. The more amusing the exercise can be made, the more beneficial it will be. This exercise should not be carried out when the decks are wet.

PART VII

MUSIC AND BUGLE-CALLS

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BUGLE-CALLS, SIGNALS, AND MARCHES

GENERAL REMARKS.

1. The music in the following pages gives the authorized bugle-calls, drill-signals, and the most common marches used in the U. S. Navy.

2. The bugle-calls and drill-signals will conform strictly to the music as herein printed, and the various calls will be used only for the purpose indicated under the explanations and definitions. Particular attention must be given to *time*. While the employment of the bugle for any particular occasion is not mandatory, it is important that the calls always have the same signification.

3. All buglers and trumpeters are instructed in sounding a number of marches, both quickstep and double, but it is considered sufficient to embody only a few of these in the music. These are sufficient for reference, though others may be used if desirable. In regard to the double-time, any six-eight quickstep may be used as a double-time by playing it more rapidly. (See quicksteps Nos. 4 and 5.)

4. Infantry- and artillery-calls, and certain routine- and miscellaneous-calls, are identical in the Army and Navy.

5. Certain calls, which are primarily infantry- or artillery-calls, have been adapted to additional uses on shipboard, as indicated in the table.

6. Most calls are sounded by one bugler or trumpeter, but such general calls as *colors* (both morning and evening), *reveille*, *tattoo*, *tags*, *general-quarters*, *abandon-ship*, the *assembly*, *flourishes*, and *ruffles* are sounded by all the field-music simultaneously.

7. The table below gives a list of the approved bugle-calls of the U. S. Navy, together with a brief description of the use of each, and the name of the call when used in the U. S. Army. Many of the calls given herein are not used frequently on board ship, being supplanted by signals given by the pipe or by word of mouth.

ROUTINE-CALLS.

Note.—The number in second column is the number of the call in the list of appended music.

NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY-CALL.
Reveille.	1	Beaten or sounded when all hands are called in the morning. "The morning gun is fired at the first note of reveille, and all-hands" is piped immediately after the call is finished.	Reveille.
Tattoo.	2	Beaten or sounded at 9 p. m. In port as a signal for silence to be maintained about the decks. The evening gun is fired at the last note of tattoo and it is usually followed immediately by "pipe-down," and about three minutes later by taps.	Tattoo.
Taps.	3	Sounded about three minutes after pipe-down. It is a signal for all men to <i>turn-in</i> for the night and maintain silence.	Taps.
First-Call.	4	Sounded five minutes before morning and evening colors, and tattoo. It calls buglers to assemble, and also is a warning-signal to others who participate in the evolution, such as quartermaster, electricians, lamp-lighters, etc. It may also be used as a preliminary call at other times when it is desired to assemble the buglers.	Assembly of Trumpeters.
Morning-Colors,	5	Sounded after the three ruffles and flourishes. The flag leaves the deck at the first note. On board ship only the first part of the call is sounded. On shore the whole call is sounded.	To the Color.
Evening-Colors,	6	Sounded at sunset, immediately following the three ruffles and flourishes. The flag leaves the truck or peak at the first note.	Retreat.

ROUTINE-CALLS.—*Continued.*

NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY-CALL.
Officers'-Call.	7	Sounded five minutes before a formation at which officers must be present. It is also used at other times, when specially provided for, such as to call all officers to assemble at a certain designated point. For example, at general quarters it may be used to call all officers to assemble on the bridge or at a previously-designated position.	Officers'-Call.
Assembly.	8	Signal for divisions to assemble for muster, as described in Part I, Art. 39.	Assembly.
Drill-Call.	9	Signal to assemble for drill; or if already assembled, to proceed with the drill or exercises.	Drill-Call.
Secure.	10	Signal to <i>secure</i> , used after emergency-drills.	.....
Recall.	11	Sounded to recall men who are out of the ship for drill or for exercise, such as at boat-drill, infantry or artillery on the dock, in swimming, etc.	Recall.
Dismiss (Retreat from Drill.)	12	Signal to dismiss from drill. Sounded after <i>secure</i> , or sounded alone after ordinary ship-drills.	.....
Sick-Call.	13	Usually sounded between 8 and 9 a. m. as a signal for men requiring medical attention to report at the sick-bay.	Sick.
Band-Call.	14	Used to call the band to the quarter-deck.	.....
Full-Guard.	15	Calls the whole guard to the quarter-deck.	1st Sergeant's-Call.
Sergeant's-Guard.	16	First two bars of Full-Guard call. Calls sergeant's-guard to the quarter-deck.	.....

ROUTINE-CALLS.—*Continued.*

NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY-CALL.
Mess-Call.	17	This call is not ordinarily used on cruising-vessels, but is used on training-vessels as a signal for the crew to form by messes preparatory to marching to their meals. It is also a signal to spread mess-gear. If used on a cruising-ship it would have that signification.	Mess.
Provision-Call.	18	Sounded about 2 p. m. as a signal that provisions are about to be served out. Also used after Collision-Drill, Fire-Drill, etc., as a signal to get up provisions preparatory to abandoning ship.	Issue.
Silence (or Attention.)	54	When sounded for a passing vessel it is a positive command for every man in sight from outboard to stand at attention in his tracks, facing the passing vessel. If used at drill or fleet-maneuvres, it is an order for every one to stand at attention and maintain silence.	Attention.
Carry-On.	19	Sounded after <i>silence</i> , is a signal to resume conditions existing before <i>silence</i> was sounded.	.....
Hammocks.	20	Is a signal for every man using a hammock to fall in abreast his hammock, and maintain silence.	.....
Clean Bright-Work.	21	Signal to clean assigned bright-work. Followed by <i>one</i> blast means clean deck bright-work; <i>two</i> blasts, gun bright-work.	.....
Knock off Bright-Work.	22	Signal to stow away all cleaning-gear.	.....

MISCELLANEOUS-CALLS.

NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY-CALL.
Clear Ship for Action.	23	This call, on board ship is a signal to <i>clear ship for action</i> ; on shore it is the signal <i>To Arms</i> .	To Arms.
General-Quarters.	24	Signal for every man to go to his station for general-quarters, and to <i>Cast loose and provide</i>.	.....
Abandon-Ship.	25	The signal to equip boats for abandon-ship and to shove off.	General. (Abbreviated.)
Fire-Call.	26	Sounded simultaneously with the ringing of ship's bell. One blast, fire forward; two blasts, aft. Usually followed by <i>assembly</i> , which is a signal for men to fall in at quarters for muster when their duties are completed.	.....
Swimming-Call.	27	Signal to prepare for swimming, put on trunks, etc.	.....
Go in Water.	28	Signal to go in the water for swimming. Sounded after boat is in position and boom lowered. Sometimes called "overboard."	.....
Church-Call.	29	Sounded as a signal that church is rigged, and that Divine Service is about to be held. It is followed by tolling the ship's bell.	Church.
Flourishes.	30	Are sounded on the bugle as a mark of respect to the colors, to officials of high rank, etc., the number in this case never in excess of four, depending on the rank of the official.	Flourishes for Review.
Ruffles.	31	Are beaten on a drum, accompanying the flourishes, and in the same number in each case.	Ruffles.
Extra-duty-Call.	32	Signal for extra-duty men to fall in at designated position.	Fatigue.

MISCELLANEOUS CALLS.—Continued.

NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.	ARMY-CALL.
Division-Call.	33	Calls designated division to quarters. It is half of assembly followed by blasts to indicate the division.	.....
Man Overboard.	59	Used as a signal that there is a man overboard.	Charge.
School-Call.	34	Used on training- and school-ships, and at training-stations, to call classes to their studies.	.....
Saluting Gun-Crews to Quarters.	35	Sound as a signal to all concerned to make all necessary preparations to fire a salute.	Stable-Call.
Belay.	36	Used to countermand or revoke a call just preceding it.	.....
Bear a Hand.	58	Same as double time. Used to indicate haste in obeying previous call.	Double Time.
Point Guns Forward.	60	The same as guide right. Used in general-quarters drill.	.....
Point Guns Aft.	61	The same as guide left. Used at general-quarters.	.....
Point Guns Abeam.	62	The same as guide center. Used at general-quarters.	.....
Elevate.	65	The same as Squads right, MARCH.	.....
Depress.	66	The same as Squads left, MARCH.	.....
Man the Starboard Battery.	75	The same as On right into line.	.....
Man the Port Battery.	76	The same as On left into line.	.....

BOAT-CALLS.

NOTE.—If there be more than one boat of a kind, its number is indicated by the proper number of blasts following the main-call.

NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.
Steamers.	37	Used to call away or designate the steamer indicated by the blasts. The steam-arge is called away as a steamer.
Launches.	38	Calls away or designates the sailing-launch indicated.
Cutters.	39	Calls away or designates the cutter indicated.
Whale-boats.	40	Calls away or designates the whale-boat indicated.
Barge.	41	Calls away or designates the barge indicated.
Gig.	42	Calls away or designates the gig indicated.
Dinghy.	43	Calls away or designates the dinghy indicated, call repeated.
Wherry.	43	Calls away or designates the wherry indicated. Call sounded once.
Away all Boats.	44	Calls away all boats either for exercise or when all boats are to be used for landing, or for an armed boat-expedition.
Hook-on.	45	Signal to hook on and prepare for hoisting the boat or boats whose call precedes the <i>hook-on</i> . To hook on all boats, sound "Away all boats" and follow it by "Hook-on."
Man the Boat-falls.	46	Signal for all hands to man the boat-falls which may be indicated by word of mouth or by boat-call.
Muster Boat-crews.	47	Signal for all boat-crews to fall in at assigned places for muster, or individual boat-crews may be designated by the boat-call.

INFANTRY- AND ARTILLERY-CALLS.

8. These calls are the same, and they are used for the same purpose, as corresponding calls in the U. S. Army. Remarks on their use on shore are given below.

9. Aside from the drill-signals, whose use is evident from their names, the following calls, not ordinarily used on board ship, are used on shore; as, for example, with the Naval Brigade or a battalion in camp or in barracks.

ARMY- AND NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.
Guard-mounting.	48	The first or preparatory signal for guard-mounting. The second call is the assembly.
Company-Commander's Call.	49	Signal for company-commanders to convene at previously-designated position.
Call to Quarters.	50	Used on shore in barracks or in camp as a signal for men to go to their quarters or tents. It is usually sounded about five minutes before taps, depending on regulations. In such cases tattoo will usually be sounded one-half hour before taps.
Dress-Parade.	51	Warning signal for companies to form for dress-parade. The signal for the companies to fall in is the assembly.
Adjutant's-Call.	52	Signal for companies to form battalion. Immediately after this call the adjutant posts the guides of color-company and that company marches on line. Used also on ship to form battalion.
General.	53	Signal for striking tents and loading wagons preparatory to marching.

REMARKS ON THE USE OF BUGLE-CALLS ON SHORE.

NOTE.—In the following remarks the army names of the various calls are used. The call is indicated by the number abreast each, which refers to the number of the call in the music which is appended.

Warning-Calls.

10. First-call (4), guard-mounting (48), dress-parade (51), and drill (9) precede the assembly (8) by such interval as may be prescribed by the commanding-officer.

11. **Mess** (17), **church** (29), and **fatigue** (32), classed as service-calls, may also be used as warning-calls.
12. **First-call** (4) is the first signal for formation for roll-call and for all ceremonies except guard-mounting.
13. **Guard-mounting** (48) is the first signal for guard-mounting.
14. The field-music assembles at *first-call* and *guard-mounting*.

Formation-Calls.

15. **Assembly** (8): the signal for companies or details to fall in.
16. **Adjutant's-call** (52): the signal for companies to form battalion, also for the guard-details to form for guard-mounting on the camp or garrison-parade ground; it follows the assembly at such interval as may be prescribed by the commanding-officer.
17. **To the color** (5) is sounded when the color salutes; it is also used as the signal for the battalion to form brigade.

Alarm-Calls.

18. **Fire-call** (26): the signal for the men to fall in, without arms, to extinguish fire.
19. **To arms** (23): the signal for the men to fall in, under arms, on their company-parade grounds as quickly as possible.

Service-Calls.

20. **Tattoo** (2), **taps** (3), **mess** (17), **sick** (13), **church** (29), **recall** (11), **officers'** (7), **company-commanders'** (49), **1. p. o.'s** (15), **fatigue** (32), **school** (34), and **the general** (53).
21. **Reveille** (1) precedes the *assembly* (8) for roll-call; *retreat* (6) follows the *assembly*, the interval between being only that required for formation and roll-call, except when there is parade.
22. **Taps** (3) is the signal for extinguishing lights; it is usually preceded by *call to quarters* (50) by such interval as prescribed by Regulations.
23. **Assembly**, **reveille**, **retreat**, **adjutant's-call**, **to the color**, the **flourishes**, **ruffles**, and the **marches** are sounded by all the field-music united; the other calls, as a rule, are sounded by the musician of the guard or orderly musician; he may also sound the assembly when the musicians are not united.
24. **The morning gun** is fired at the first note of *reveille*, or

if marches be played before reveille, it is fired at the commencement of the first march.

25. The evening gun is fired at the last note of *retreat*.

DRILL-SIGNALS.

26. (1) The drill-signals include both the preparatory commands and the commands of execution; the last note is the command of execution.

(2) When a command is given by the bugle, the chiefs of subdivisions give the proper commands orally.

(3) The memorizing of these signals is facilitated by observing that all signals for movements to the *right* are on the *ascending scale*, that the signals for the same movements to the *left* are corresponding signals on the *descending scale*; that changes of gait are all on the same note; that c. c.'s *call* is the first two bars of *officers'-call* with the *attention* added.

(4) The various calls are given in the music. The meaning of each is apparent from its name. 63 and 64 are preparatory signals to indicate simultaneous movements by companies or battalions.

MARCHES AND QUICKSTEPS.

NAVY-CALL.	NUMBER OF CALL.	EXPLANATION OF USE.
President's March.	93	Played when President visits a ship-of-war.
C-in-C's. March.	94	Played when a flag-officer comes on board officially. Same as the Army General's March.
Rogue's March.	95	Played when a thief or other man is expelled from camp in disgrace.
Funeral March.	96	Played at funerals.
Quickstep No. 1.	97	Played as a march.
Quickstep No. 2.	98	Played as a march.
Quickstep No. 3.	99	Played as a march.
Quickstep No. 4.	100	Played as a march; also as a double.
Quickstep No. 5.	101	This is an ordinary 6/8 quickstep but is generally used as a double by playing it more rapidly.

BUGLE CALLS USED ON BOARD SHIP

ROUTINE-CALLS.

1. Reveille.

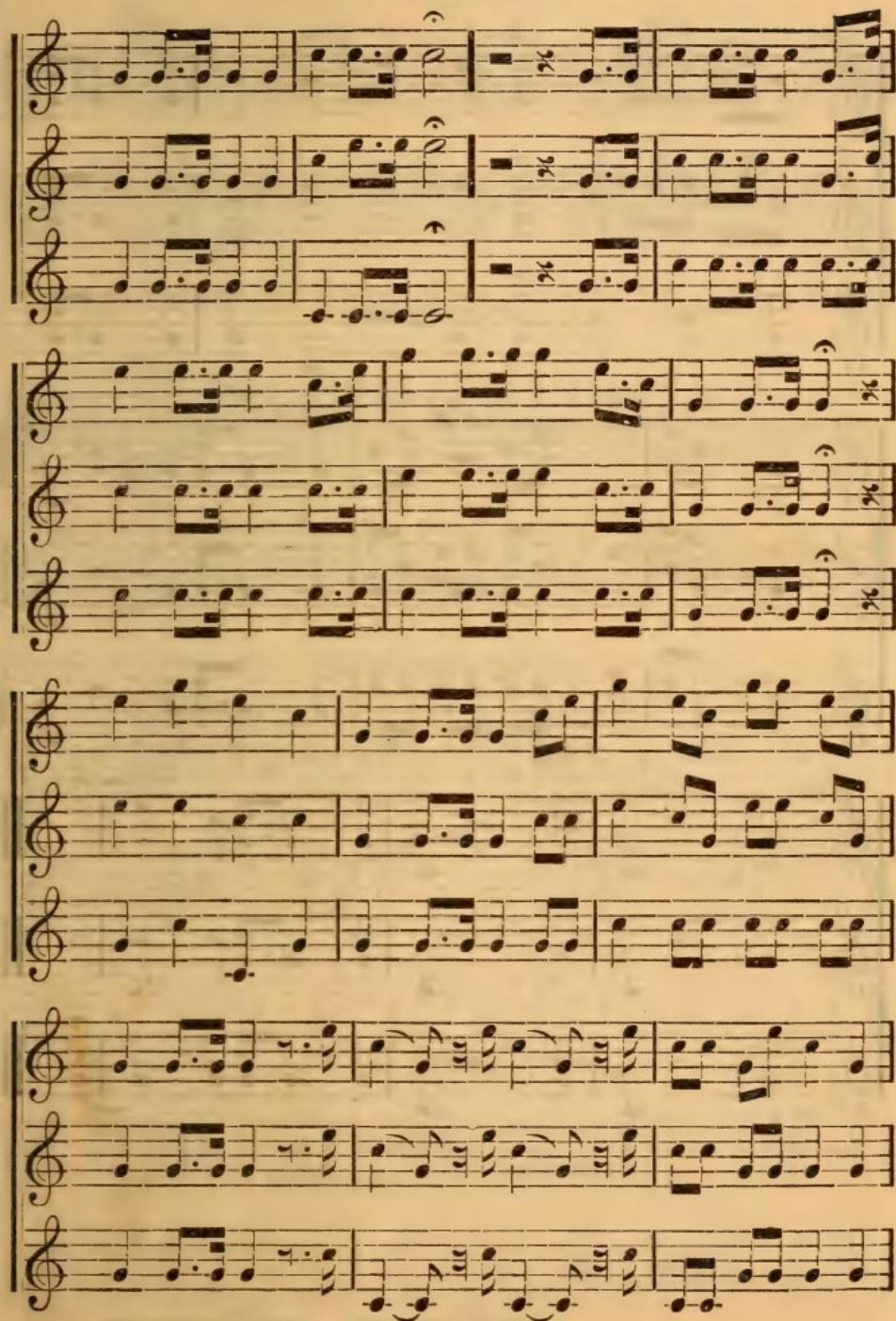
Quick.

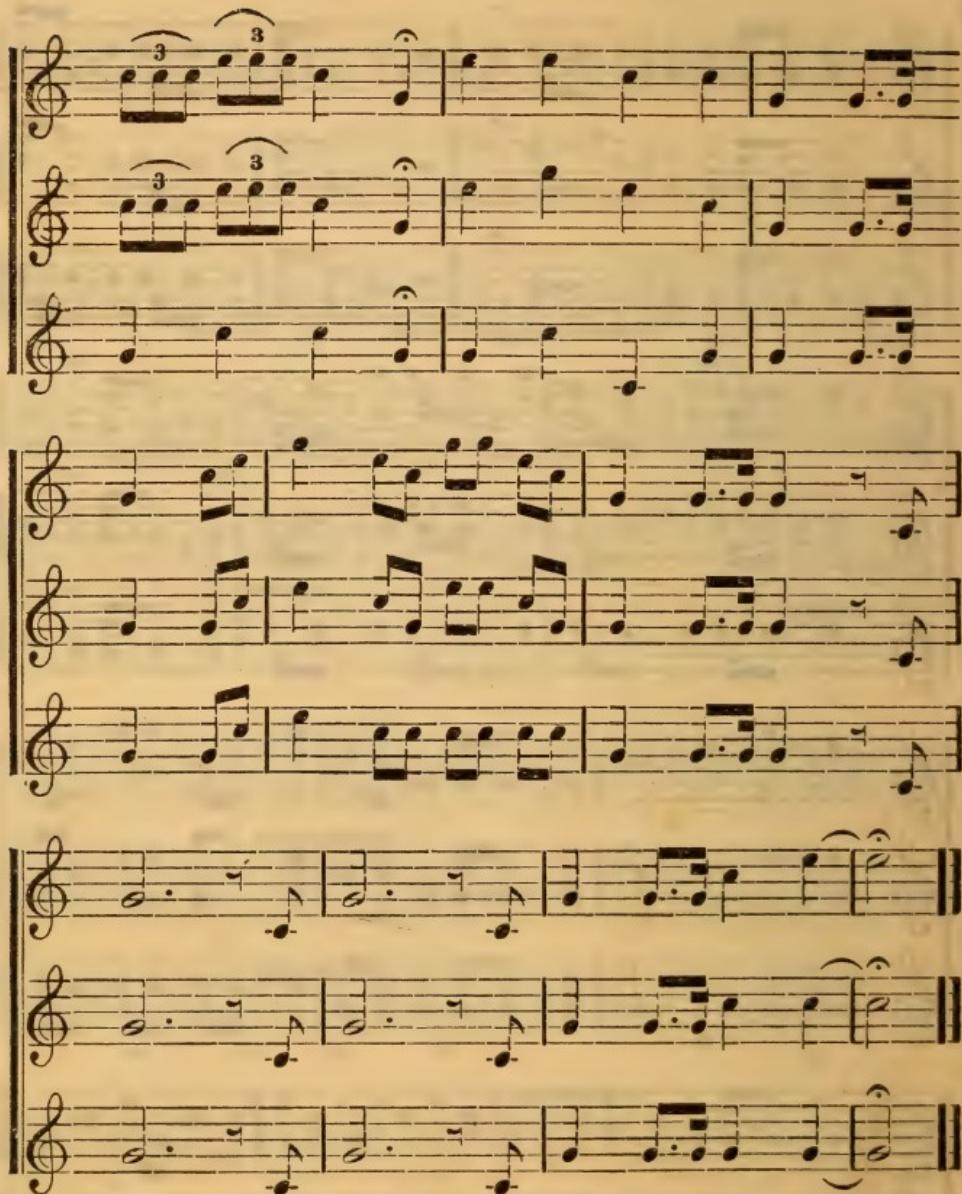
Musical score for the bugle call "Reveille". The score consists of three staves of music in 2/4 time, treble clef, and F major. The first two staves are identical, ending with a "FINE." The third staff begins with a different melodic line and ends with "D.C." (Da Capo).

2. Tattoo.

Quick.

Musical score for the bugle call "Tattoo". The score consists of six staves of music in common time, treble clef, and F major. It features a repeating rhythmic pattern of eighth and sixteenth notes.

Tattoo.—*Continued.*

Tattoo.—*Continued.*

3. Taps.

Slow.

4. First-Call.

Quick.

5. Morning-Colors.

Quick time.

FINE.

D.C.

6. Evening-Colors.

Moderato.

The music is composed of 12 staves of musical notation. The first staff begins with a quarter note followed by eighth-note pairs. Subsequent staves show various rhythmic patterns including eighth-note pairs, sixteenth-note groups, and eighth-note triplets. Measures 7 through 10 feature a prominent eighth-note triplet pattern. Measures 11 and 12 conclude with a final eighth-note triplet.

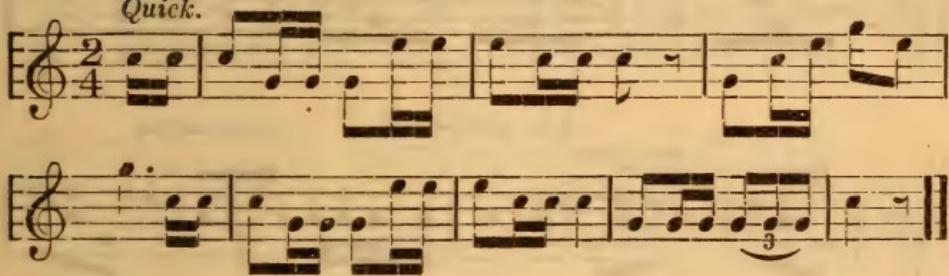
7. Officers'-Call.

Quick.

8. Assembly.

Moderato.

9. Drill-Call.

Quick.

10. Secure.



11. Recall.

Moderato.

2/4

3

3

3

12. Dismiss (Retreat from Drill).

Quick.

6/8

13. Sick-Call.

Quick.

2/4

3

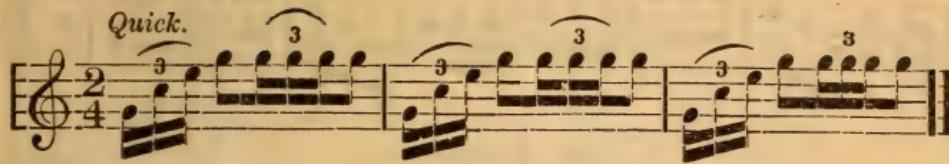
3

3

14. Band-Call.

2/4

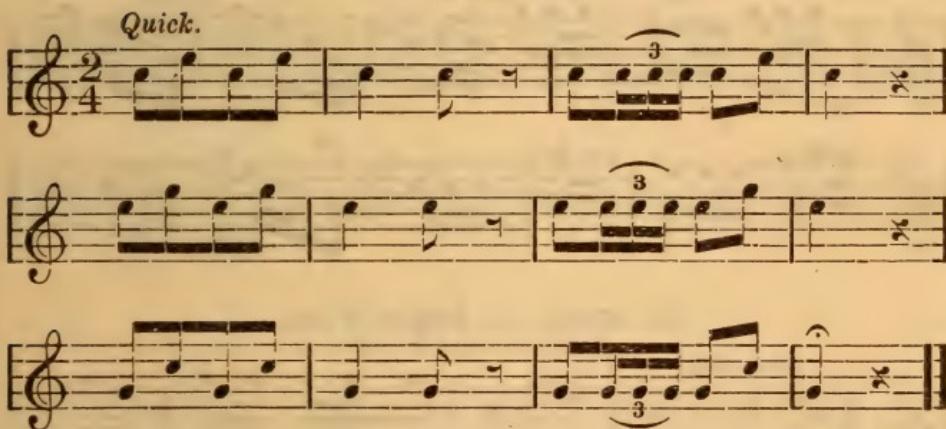
15. Full-Guard.



16. Sergeant's-Guard.



17. Mess-Call.



18. Provision-Call.



19. Carry-On.



20. Hammocks.



21. Clean Bright-Work.

NOTE.—Followed by one blast, deck bright-work; two blasts, gun bright-work.

Quick.



22. Knock off Bright-Work.

Moderato.



MISCELLANEOUS CALLS.

23. Clear Ship for Action.

24. General-Quarters.

A musical score consisting of two staves. The top staff is in 2/4 time and has a tempo marking 'Quick.' above it. The bottom staff is in 4/4 time. Both staves feature eighth-note patterns with various slurs and grace notes.

25. Abandon-Ship.

The image shows three staves of musical notation. The top staff uses a treble clef and consists of six measures. The first measure contains six eighth-note pairs grouped by vertical bar lines. The second measure contains six eighth-note pairs grouped by vertical bar lines. The third measure contains six eighth-note pairs grouped by vertical bar lines. The fourth measure contains six eighth-note pairs grouped by vertical bar lines. The fifth measure contains six eighth-note pairs grouped by vertical bar lines. The sixth measure contains six eighth-note pairs grouped by vertical bar lines. The middle staff uses a treble clef and consists of four measures. The first measure contains two eighth notes followed by a rest. The second measure contains two eighth notes followed by a rest. The third measure contains two eighth notes followed by a rest. The fourth measure contains two eighth notes followed by a rest. The bottom staff uses a treble clef and consists of four measures. The first measure contains two eighth notes followed by a rest. The second measure contains two eighth notes followed by a rest. The third measure contains two eighth notes followed by a rest. The fourth measure contains two eighth notes followed by a rest.

26. Fire-Call.

Quick.

Measures 1-3: Treble clef, common time. Measure 1: Two eighth notes followed by a sixteenth note. Measure 2: A sixteenth note followed by two eighth notes. Measure 3: A sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note.

Measure 4: Treble clef, common time. Measures 4-5: A sixteenth-note pattern consisting of a sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note, repeated twice.

Repeat at will.

Measure 6: Treble clef, common time. Measures 6-7: A sixteenth-note pattern consisting of a sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note, repeated twice.

27. Swimming-Call.

Measures 1-2: Treble clef, common time. Measures 1-2: A sixteenth-note pattern consisting of a sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note, repeated twice.

Measures 3-4: Treble clef, common time. Measures 3-4: A sixteenth-note pattern consisting of a sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note, repeated twice.

28. Go in the Water (Overboard).

Measures 1-2: Treble clef, common time. Measures 1-2: A sixteenth-note pattern consisting of a sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note, repeated twice.

29. Church-Call.

Slow.

Measures 1-2: Treble clef, common time. Measures 1-2: A sixteenth-note pattern consisting of a sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note, repeated twice.

Measures 3-4: Treble clef, common time. Measures 3-4: A sixteenth-note pattern consisting of a sixteenth note followed by a eighth note, then a sixteenth note followed by a eighth note, repeated twice.

30. Flourishes.

Quick.

31. Ruffles (for the Drum).

32. Extra-Duty-Call.

Quick.

33. Division-Call.

NOTE.—Sounded once, followed by one or more blasts to indicate division.

Moderato.

34. School-Call.

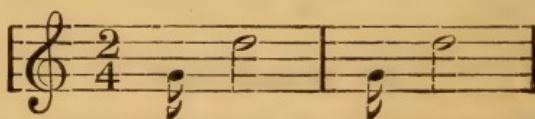
Quick.

35. Saluting Gun-Crews to Quarters.



36. Belay (to Revoke a Call).

NOTE.—Repeat the call, if necessary, and then sound *belay*.



BOAT-CALLS.

NOTE.—If there be more than one boat of a kind its number is indicated by the proper number of blasts following the main-call.

37. Steamers.

38. Sailing-Launches.

39. Cutters.

40. Whaleboats.

41. Barge.

A musical score for two staves. The top staff is in common time (C) and the bottom staff is in 2/4 time. Both staves use a treble clef. The top staff has a key signature of one sharp (F#). The bottom staff has a key signature of one flat (B-flat). The music consists of eighth-note patterns.

42. Gig.

A musical score for two voices. The top staff uses a treble clef and 2/4 time signature. The bottom staff uses a bass clef. Both staves begin with a quarter note followed by a eighth note. The first measure ends with a repeat sign and a double bar line. The second measure begins with a dotted half note, followed by a eighth note, a sixteenth note, and a eighth note. The third measure begins with a eighth note, followed by a sixteenth note, a eighth note, and a eighth note. The fourth measure begins with a eighth note, followed by a sixteenth note, a eighth note, and a eighth note.

43. Dinghy (or Wherry).

NOTE.—To call away dinghy sound this call twice, followed by one or two blasts. To call away wherry, sound this call once, followed by blasts if necessary.

A musical score for piano, showing two staves. The top staff uses a treble clef and a 2/4 time signature, starting with a forte dynamic (f). It contains measures 11 and 12, which include eighth-note patterns and sixteenth-note chords. The bottom staff uses a bass clef and a 2/4 time signature, continuing from measure 11. Measure 11 ends with a half note, and measure 12 begins with a quarter note.

44. Away all Boats.

45. Hook-On.



46. Man the Boat-Falls.



47. Muster Boat-Crews.



INFANTRY- AND ARTILLERY-CALLS.

ADDITIONAL CALLS USED MAINLY ON SHORE.

48. Guard-Mounting.

Quick.

49. Company-Commander's Call.

Quick.

50. Call to Quarters.

Slow.

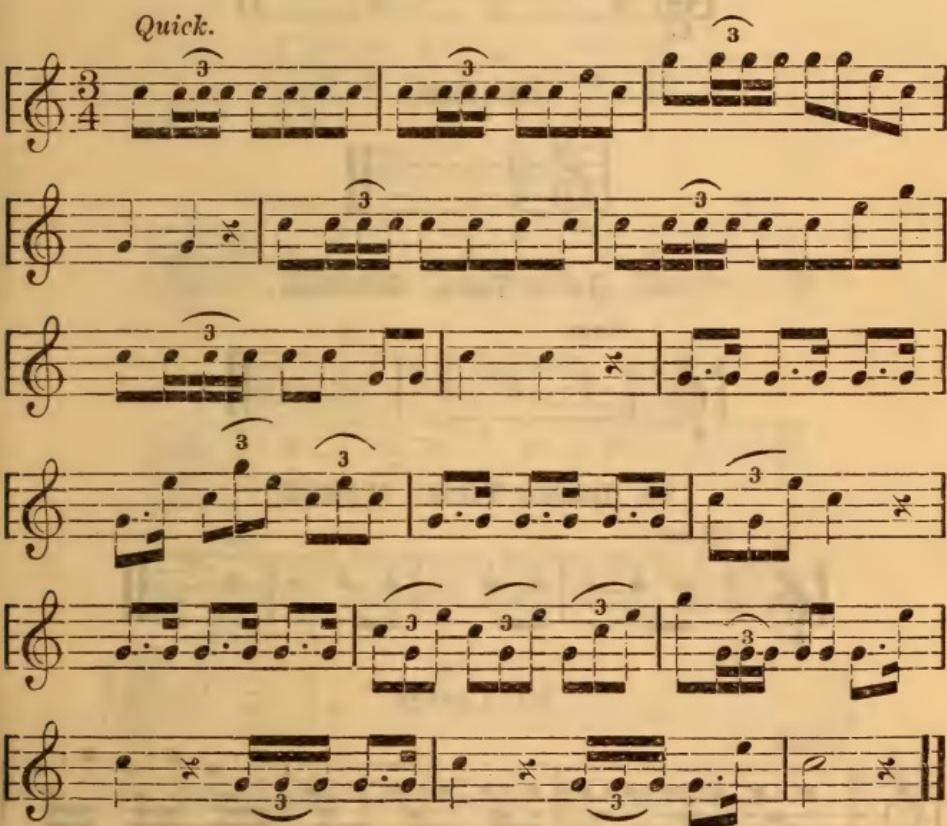
51. Dress-Parade.

Quick.

52. Adjutant's-Call.

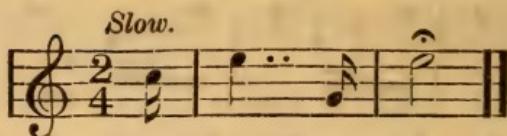


53. General.

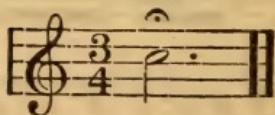


DRILL-SIGNALS.

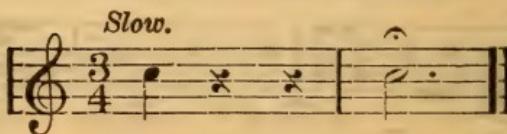
54. Attention (or Silence).

55. Forward; or, Full Step. MARCH.
(Or Man the Drags.)

56. Halt.



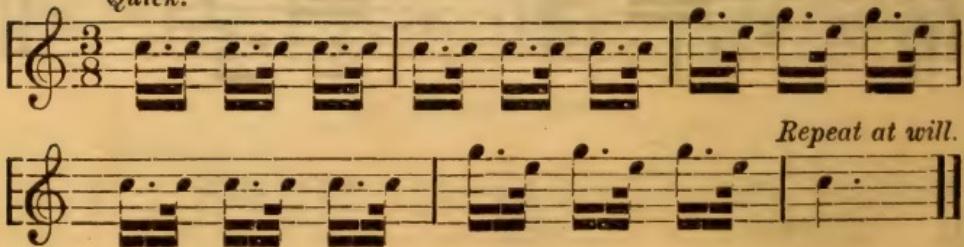
57. Quick Time. MARCH.



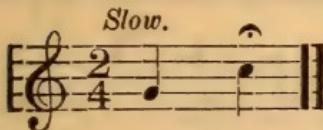
58. Double Time. MARCH.

Quick.

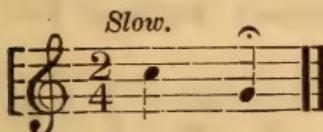
59. Charge.

Quick.

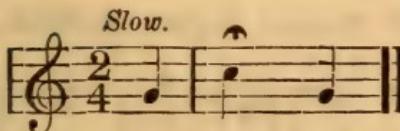
60. Guide Right.



61. Guide Left.



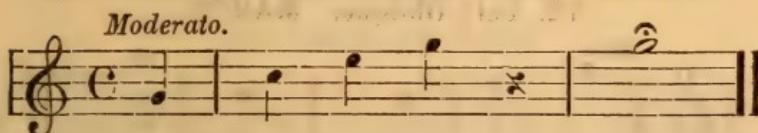
62. Guide Center.



63. Companies.



64. Battalions.

65. Squads Right; or, By the Right Flank.
(In Artillery, Sections Right Turn.) MARCH.66. Squads Left; or, By the Left Flank.
(In Artillery, Sections Left Turn.) MARCH.

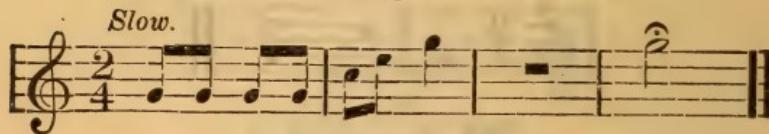
67. Squads (In Artillery, Sections) Right About. MARCH.



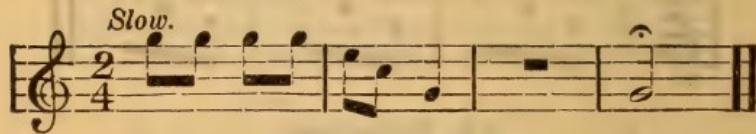
68. Squads (In Artillery, Sections) Left About. MARCH.



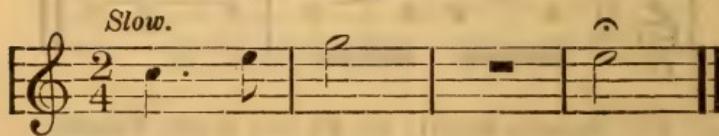
69. Column Right. MARCH.



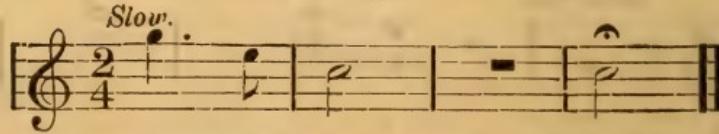
70. Column Left. MARCH.



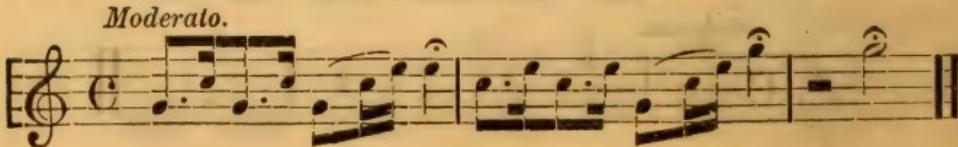
71. Right Oblique. MARCH.



72. Left Oblique. MARCH.



73. Right Front into Line. MARCH.



74. Left Front into Line. MARCH.

Moderato.

75. On Right into Line. MARCH.

Moderato.

76. On Left into Line. MARCH.

Moderato.

77. Company (or Companies) Right. MARCH.

(In Artillery, Platoons Right Turn.)

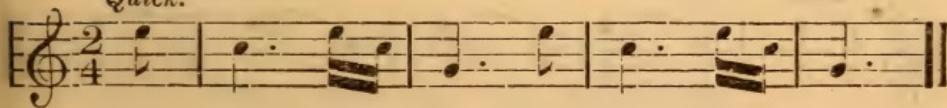
Moderato.

78. Company (or Companies) Left. MARCH.

(In Artillery, Platoons Left Turn.)

Moderato.

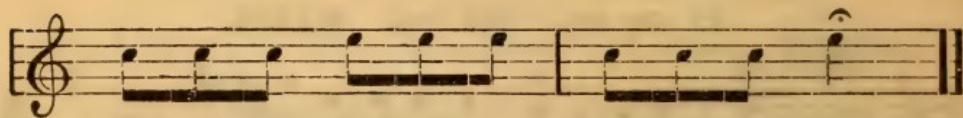
79. Commence Firing.

Quick.

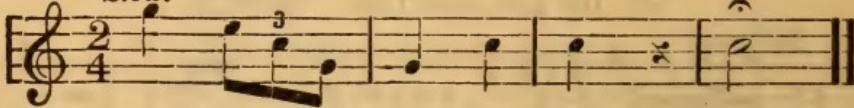
80. Cease Firing.

Quick.

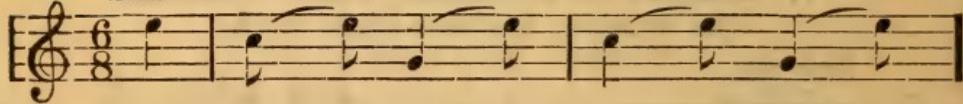
81. As Skirmishers. MARCH.

Quick.

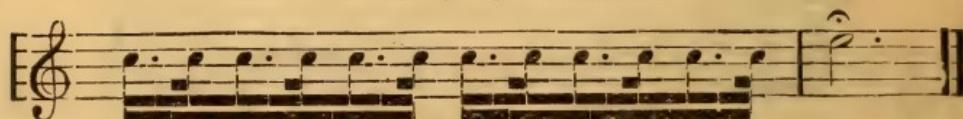
82. To the Rear. MARCH.

Slow.

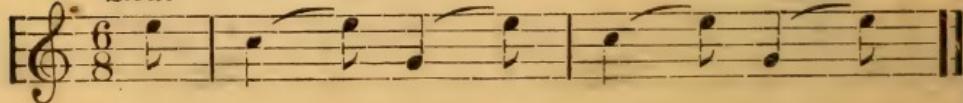
83. Rally by Company.

Slow.

84. Rally by Sections.



85. Rally by Squads.

Slow.

86. Face to the Rear.

Slow.

87. In Battery.

Moderato.

88. From the Right, Front into Echelon.

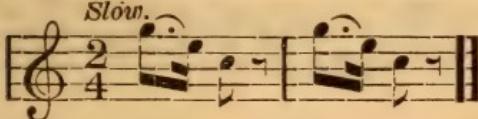
Moderato.

89. From the Left, Front into Echelon.

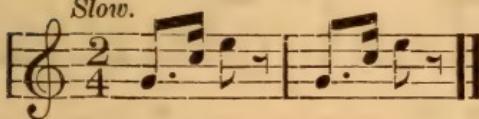
NOTE.—From the right (or left) rear into echelon are the same calls as 88 and 89, respectively, followed by FACE TO THE REAR (86).

Moderato.

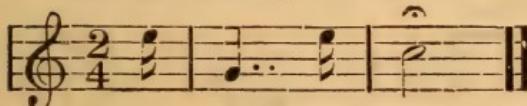
90. Lie Down.

Slow.

91. Rise.

Slow.

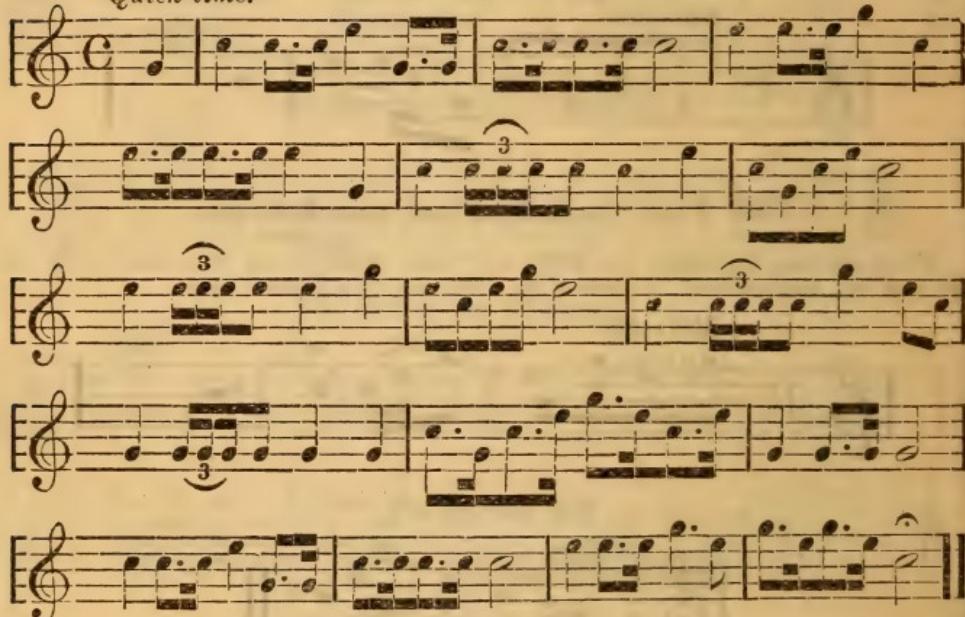
92. Route Step. MARCH.



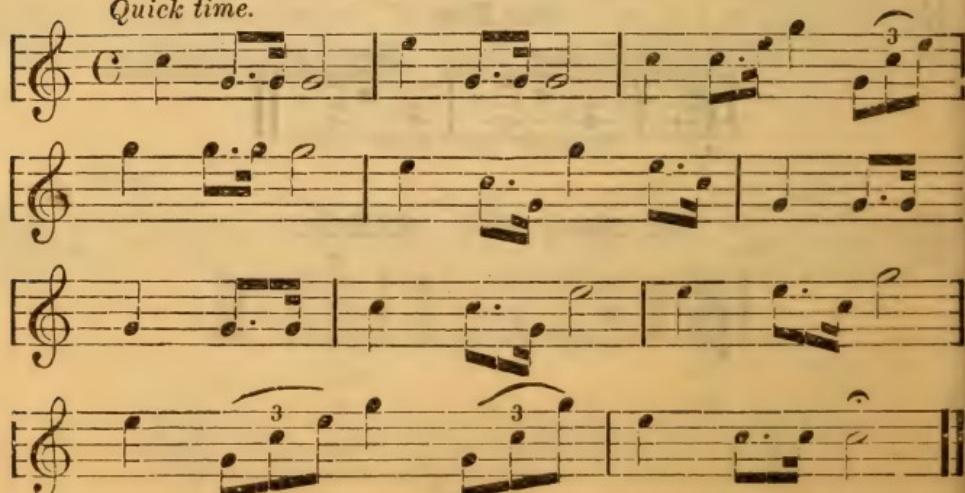
MARCHES AND QUICKSTEPS.

MARCHES.

93. President's March.

Quick time.

94. Commander-in-Chief's March.

Quick time.

Quick time.

95. Rogue's March.

Musical score for "Rogue's March" in quick time. The score consists of three staves of music. The first two staves are identical, featuring eighth-note patterns. The third staff begins with a sixteenth-note pattern followed by a repeat sign and a section labeled "Repeat at will." The key signature is common time (C), and the tempo is indicated as "Quick time."

Very slow.

96. Funeral March.

Musical score for "Funeral March" in very slow time. The score consists of ten staves of music. The first five staves begin with dynamic markings "f" (fortissimo). The subsequent staves show a variety of dynamics, including "p" (pianissimo) and "f" (fortissimo). The score concludes with a section labeled "Repeat at will." The key signature is common time (C).

QUICKSTEPS.

97. Quickstep No. 1.

Quick.

End.

End.

End.

End.

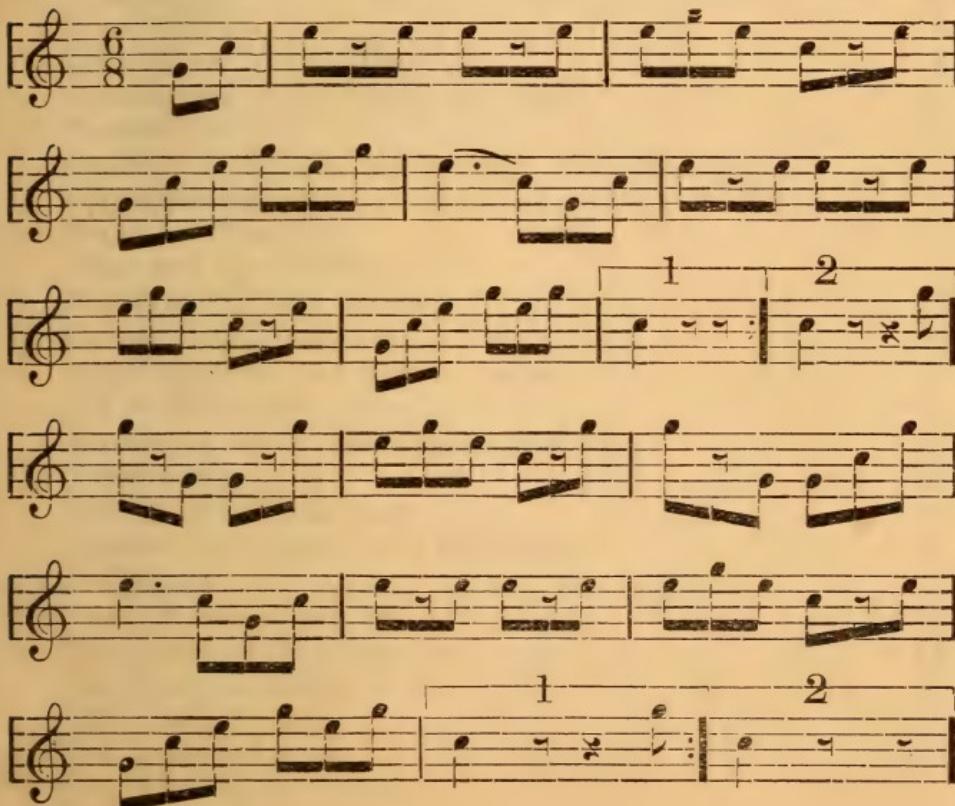
98. Quickstep No. 2.

99. Quickstep No. 3.



100. Quickstep No. 4.

NOTE.—This may also be used as a double.



101. Quickstep No. 5.

NOTE.—Used chiefly as a double, but may also be used as a quickstep.

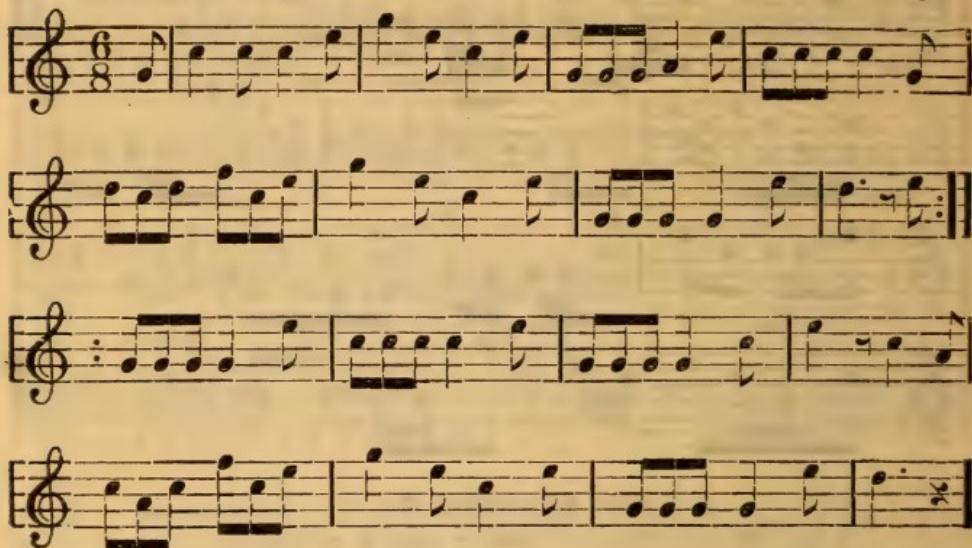


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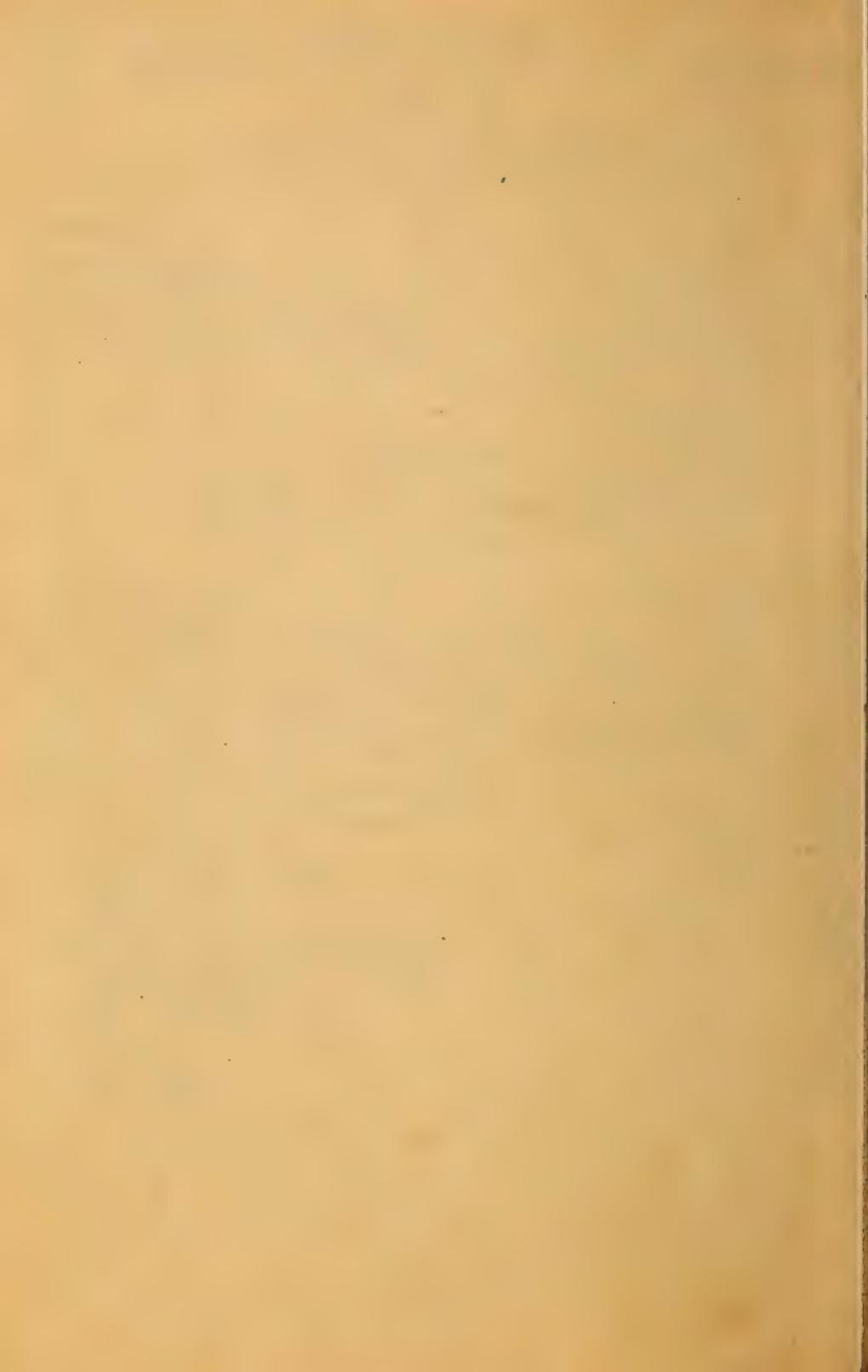
PHYSICAL EXERCISES.

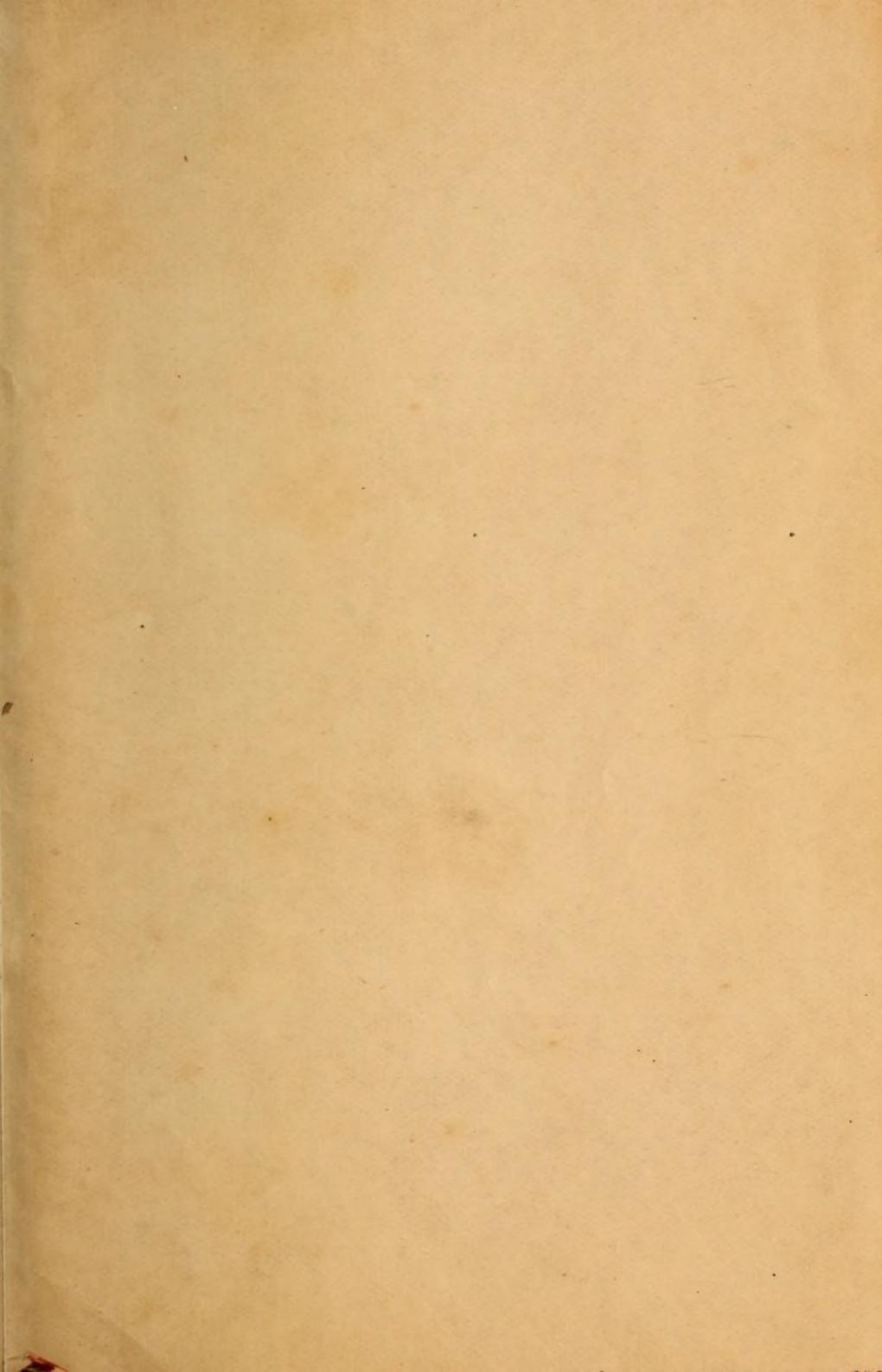
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